WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

OPAG ON INFORMATION SYSTEMS AND SERVICES

MEETING OF THE EXPERT TEAM ON DATA REPRESENTATION AND CODES

FINAL REPORT

PRAGUE, 22-26 APRIL 2002

EXECUTIVE SUMMARY

The Meeting of the Expert Team Data Representation and Codes (ET/DR&C) was held, at the kind invitation of Czech Republic at Czech Hydrometeorological Institute (CHMI) in Prague, from 22 to 26 April 2002.

The Team reviewed the status of validation tests for the new FM 92 GRIB Edition 2 encoding/decoding. Further validation tests and experimental exchanges were recommended with a view to the use of GRIB 2 at the end of 2002, especially for the exchange of Ensemble Prediction System products. Few additional templates were recommended. Increase of bulletin size on GTS to accommodate GRIB 2, higher resolution and ensemble products was strongly requested to GTS relevant Expert Teams (up to 250 K). The Team recommended the production of a Guide on GRIB Edition 2.

The Team discussed, finalized and recommended additions to BUFR/CREX tables for the transmission of automatic stations (AWS) observations, for approval by CBS Ext. 02. The Meeting also approved proposal for BUFR/CREX templates for AWS. EUMETNET countries will exchange these information before the end of 2002. The templates to represent in BUFR/CREX, SYNOP, SHIP, BATHY/TESAC, BUOY, simple AMDAR, AIREP, TEMP+PILOT and METAR+SPECI were approved. Templates for CLIMAT codes data in BUFR were approved, but endorsement by CCl and further validation were requested.

Following request by several Members, the Team recommended new additions to BUFR/CREX tables for

- Exchanging geostationary satellite radiance data
- Transmission of ensemble tropical cyclone tracks in BUFR/CREX
- Transmission of AMDAR data and AMDAR vertical profile (ascent/descent of aircraft) (and approved the corresponding templates)
- New monitoring information
- New Common Table C-11 for Originating Centres
- New Table B descriptors for use with AMSU A/B satellite data
- Addition to clarify a regulation on replication operation in BUFR
- New Table B descriptors for use with next generation Rawindsonde data (from USA)
- To code in BUFR, SIGMET on Volcanic ash information
- Descriptors for use in reporting certain types of AIRS satellite data
- Additional entries in BUFR code tables to support JASON satellite data

At the request of USA, the Team recommended for validation with a view to introduce a new BUFR edition in 2005, additional operator descriptors in Table C for:

- Representation of Probabilities and other Forecast Data
- Simplifying the procedure of increasing descriptor precision
- Changing data width for CCITT IA5 elements

The Team noted that new experimental or operational exchange of new BUFR Data was taking place. USA indicated that they would make available on the GTS BUFR encoded rawindsonde data. JMA was starting to transmit wind profiler data in BUFR (about 20 stations). Ozone data were operationally exchanged in CREX as well as soil temperature data.

The problem of the required format for bulletins of METAR, SPECI and TAF was discussed and the Team accepted the proposition of ICAO to require only the name (METAR, SPECI or TAF) to be included before the report, and suppress the required line at the beginning of the bulletin. The Team recommended this new format and the other changes due to amendments 72 and 73 to ANNEX 3, for CBS, with a view to their operational implementation in November 2004. At the request of CBS XII, the modifications for reporting zero and twenty-four hours precipitation in synoptic reports were finalized with a view to their approval by CBS Ext. 02 for implementation in November 2003. At the request of Japan, the Team recommeded also an addition to one regulation for improving the coding of CLIMAT TEMP reports.

The Team discussed the document written by Mr Charles Sanders and other authors on the use of XML to exchange meteorological information. The Team admitted that the inherent verbose characteristic of XML was making it unfit to translate bulky data such as satellite, GRIB or large number of BUFR encoded observations. It was agreed that a use of XML in meteorology would be to exchange limited number of observations. This would be done at the beginning in the INTERNET environment. This would be most

appropriate to interface, first with users, external to the NMHS. XML could also be used to pass information like METNO or forecast information or warning, etc… XML could also be used to exchange documents. Another use of XML could be for an alternative mean of collection of observations at national levels or even for international exchanges in case there was no appropriate GTS link. Finally, the Team agreed that XML could be used for describing metadata of WMO exchanged files. To standardize the exchange of observations in XML, the Team agreed that a simple immediate solution would be to use as standard tags the number of BUFR/CREX descriptors which make an exhaustive list of parameters to be possibly exchanged in the operational meteorology. With such an internationally agreed standard, the exchange of simple observations in XML would be make easy between WMO Members. The Team finally recommended that CBS organise a workshop on the use of XML in meteorology to further elaborate on requirements, problems and solutions.

The additions to Table Driven Code Tables were discussed by the Team, who expressed concern on the practical delay of six months between the approbation of a modification and its possible implementation. The Team understood that the delay of 3 months, in addition to the 3 months required to notify the WMO Members, was due to the publication work for the production of the hard-copy of the Manual. The Team stressed, as said already in previous meetings, that a Master copy of the Manual kept on the WMO Web server would greatly reduce the delays, and asked the Secretariat to study this possibility. The Team noted with appreciation that the CBS Management Group (CBS-MG) had requested the nomination of national focal points for Matters relative to WMO Codes and Data Representations including the Migration to TDCF. The Team asked the Secretariat that the focal points will be informed quickly of the codes changes recommended by the ET/DR&C. The Team took note that the CBS-Management Group noted that the fast-track mechanism should be reserved for urgent operational problems. The majority of changes to the codes and code tables should follow normal procedures, i.e. should be submitted for approval by EC no later than February with later submissions being deferred to the following year. The CBS-MG said that Table changes would first be approved for experimental use by the president of CBS and would be made available as a digital file (i.e. not published in printed form), then once they had been used experimentally for one year they could be submitted for official adoption through existing formal procedures. The Team expressed concern that the current adoption of BUFR/CREX/GRIB code table updates would be made even slower. Moreover, the yearly frequency is not adequate to accommodate all needs, especially those related to satellite data. It was pointed out that with the current procedures, some data were already distributed with local descriptors, and that any additional delays would lead to a proliferation of such local entries. This would not serve the WMO community. The Team then proposed a new mechanism, with a view to accommodate both CBS-MG views and user needs. The Procedure proposed will have three steps:

- Approval (by chairs of ET, OPAG and CBS president) of allocated entries after expression of requirements. The list is kept on-line in the WMO server.
- After validation, declaration of pre-operational entries (approval by chairs of ET, OPAG and CBS president). The list is kept on-line in the WMO server.
- Approval by CBS, Executive Council and introduction in the Manual.

Finally, the Team welcomed the invitation by Dr Mhita, Permanent Representative of Tanzania with WMO and President of RA I , to hold the next meeting of the ET/DR&C in Tanzania, followed by a Training Seminar on Data Representation for RA I , where experts of the Team could lecture. The Team agreed that this will be an opportunity to help in bridging a bit the technological gap, and asked the Secretariat to organize the next Meeting in Tanzania in 2003.

CONTENTS

REPORT OF THE MEETING OF EXPERT TEAM ON DATA REPRESENTATION AND CODES
(Prague, 22-26 April 2002)

1. ORGANIZATION OF THE MEETING

1.1 OPENING OF THE MEETING

1.1.1 The Meeting of the Expert Team on Data Representation and Codes (ET/DR&C) took place at Czech Hydrometeorological Institute (CHMI) in Prague, from 22 to 26 April 2002 (the participants' list can be found in the Annex to this paragraph). The Meeting was opened on Monday 22 April at 9.30 a.m. by Dr Obrusnik, Director of CHMI and Permanent Representative of Czech Republic with WMO. Dr Obrusnik welcomed the Experts and recalled the importance of the work of the Team. He stressed that the WMO Codes were fundamental to meteorology because they made possible the real time exchange of data, the raw material for all meteorological processing and applications. The work and the resulting recommendations made by the Team will therefore concern and have implications for the whole meteorological community. Dr Obrusnik wished to all Experts a good stay in Prague.

1.1.2 The representative of the WMO Secretariat thanked CHMI for hosting the meeting and providing excellent hospitality and facilities. He thanked especially the local organisers from CHMI, like Dr Eva Cervena, and all the other staff involved, for their good work. He also took the opportunity to thank especially Dr Cervena for a very long commitment to the WMO Codes development. The Team had several challenging tasks on the agenda following the terms of reference defined by CBS:

a) maintain all WMO data representation forms and further develop table driven codes by defining descriptors, common sequences and data templates, so they meet the requirements of all members most efficiently;
b) invite and assist members to participate in the experimental exchange of data encoded in modified or new formats, in BUFR, CREX, and GRIB Edition 2 (GRIB 2) on a bilateral basis;
c) define standards for meteorological information using XML as appropriate;
d) work at the production of a guide on GRIB 2 and a new manual on reporting practices for the use of table driven codes;
e) determine the continuing use of the different WMO data representation forms and recommend options for their future roles or disposition.

The Team had also to reconsider the method of updating the Manual on Codes, as requested by the CBS Management group. The WMO secretariat representative stated also that the resulting set of recommendations will be considered in September by the ICT of the OPAG on ISS in Geneva and by the extraordinary CBS in fall 2002 in Cairns, Australia.

1.1.3 Mr Jean Clochard, Chairman of the Team, welcomed the participants and stressed that the main tasks of the team were to finalize templates for transmission of traditional observations in Table Driven Code Forms (TDCF), ensure that GRIB 2 Templates were fully adequate to transmit fields which cannot be transmitted in GRIB Edition 1 (GRIB 1), and also define a sound policy for use of XML in operational meteorology.

1.1.2 Mr Jean Clochard, as Chairman of the ET, led the Team with diplomacy and efficiency.

1.2 APPROVAL OF THE AGENDA

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

2. GRIB 2 CODE FORM

2.1 STATUS AND COORDINATION OF FINAL VALIDATION TESTS FOR GRIB 2 ENCODING/DECODING

2.1.1 Templates referred in the Code Manual as “not validated” were revisited. As regards Product Definition Templates (PDTs) 4.9 and 4.10, some related work was reported by ECMWF, which was expected to deliver on GTS EPS products using PDT 4.9 from mid-2002. Final validation arrangements should be carried on jointly by ECMWF and NCEP, so that the associated templates may be fully validated for the next update to the Manual on Codes and for CBS.

2.1.2 Validation of special templates for the transmission in GRIB 2 of cross-sections and Hovmöller-type diagrams:

Associated templates are Grid Description Templates (GDTs) 3.1000/1100/1200 and PDTs 4.1000/1001/1100/1101. They support data where the “grid” is not a horizontal projection, and are referred in the Code Manual as “experimental”. No associated validation was reported. The group suggested that the Secretariat approach the bodies or teams having required such features with a view to assist for validation.

2.2 REPORT ON EXPERIMENTAL AND OPERATIONAL EXCHANGES OF FIELDS IN GRIB 2

2.2.1 At the date of the meeting, no GRIB 2 product was reported in use over GTS, although ECMWF was expected to deliver EPS products in the following months (precipitation and wind gust probabilities). Many centres expressed their willingness to use GRIB 2 in the future and/or for new products:

- United States within AWIPS system (digital forecast and satellite products), as well as for archival format NCDC
- EUMETSAT as optional format of METEOSAT image data retrievals from its archive (planned for next summer), as well as for a cloud mask product to be delivered in MSG context
- Météo France to distribute environmental model output in RSMC context
- JMA for future EPS-related products
- UKMO after move of its headquarters

2.2.2 The Team felt that that the large use of GRIB 1 products was the main reason for the slow “take-off” of GRIB 2 use. This use being more linked to new products -such as EPS ones- than to conversion of existing ones.

2.2.3 The Team felt strongly the current GTS practice limiting messages to 15000 bytes was a significant constraint. It was felt this adversely affected transition to GRIB 2 and to exchange of larger binary products in general. The Team recommended giving strong emphasis to actions promoting the increase of TCP/IP and file transfer facilities on the GTS. It also requests raising the 15000 bytes limit for binary messages to at least 100K bytes. This is similar to the change done for alphanumeric messages, which were raised from 3.8K to 15K bytes.

2.3 RESULTS ON QUESTIONNAIRE ON GRIB 2 PACKAGES (see Annex to this paragraph)

At a the previous meeting of the ET/DR&C in Toulouse, a GRIB 2 questionnaire was designed to help validation and with a view to assist migration. It was distributed by e-mail to representatives within the Team of major NWP Centres, as well as to other potential data producers. Points addressed were current status of encoding/encoding software, willingness to participate in final validation tests, templates intended to be used, programming language used, supported platforms (hardware and operating systems) and programming languages supported by application program interface (API). At the request of the Chairman of the Expert Team on Migration to Table Driven Codes (ET/MTDCF), willingness to participate in a possible development of a standard API for GRIB 2 software was also addressed. Results are summarised in Annex to this paragraph. The question of a standard API will be raised at the ET/MTDCF meeting in Washington in May 2002.

2.4 URGENT ADDITIONS OR MODIFICATIONS TO GRIB 2 (see Annex to this paragraph)

2.4.1 USA submitted a proposal for four new Product Definition Templates (PDTs) to extend EPS products cover. Two proposals were amended for completeness as suggested in a document submitted

by JMA. It was agreed that the final validation of these templates would be done shortly after the meeting. The validation will be performed by exchanges between these two services and with the cooperation of ECMWF. Additional descriptors introduced by the JMA proposal lead to add also correction in PDTs 4.3 and 4.4 for consistency; it was agreed that this issue would be part of the validation process. These new templates will be for pre-operational implementation (see explanation of terminology in chapter 7.1) this year and will be submitted to CBS for operational implementation in November 2003.

2.4.2 At the request of Météo France, additional entries were inserted into Code Table 4.2 (Product Discipline 0, Product Category 18) to support extra products of RSMCs with specialisation to provide atmospheric transport model output, namely time integrated air borne concentrations as documented in publication WMO-TD/N. 778. These will be operational as soon as approved by the CBS president.

2.4.3 To support cloud mask products, an extra entry was inserted into Code Table 4.2 (Product Discipline 3, Product Category 0), as well as an associated code table (4.217). Following a suggestion on PDT 4.30 from EUMETSAT representative, a note recommending use of satellite series and numbers of band defined in common code tables when available, was recommended for the next Manual update. These new entry and code table will be for pre-operational implementation this year and will be submitted to CBS for operational implementation in November 2003.

2.5 OTHER GRIB RELATED ISSUES

2.5.1 Following several requests, several modifications to GRIB 1 code tables were discussed. Although such changes were in agreement with CBS recommendations (CBS-Ext. 98 Abridged Final Report, *parag. 4.4.6*), it was stressed that such changes were exceptional and not recommended in the future.

2.5.2 At the request of NCEP, three additional entries in Code Table 5 were added, among which, one was for consistency with the “Guide to GRIB (edition 1)" available on WMO server as well as in publication WMO-TD/No 611. An additional entry was also added in Code Table 3 to accommodate highest isobaric levels used in NWP (below 1 hPa), and part of the reserved entries in this table were allocated for local use. Associated modifications to GRIB 1 are described in Annex to this paragraph. These new entries will be operational as soon as approved by the CBS president.

3. BUFR AND CREX

3.1 ADDITIONS, COMMON SEQUENCES AND TEMPLATES FOR TRANSMISSION OF AUTOMATIC STATIONS OBSERVATIONS

The Team examined a refined proposals submitted by Dr Eva Cervena and Dr Igor Zahumensky resulting from a synthesis of discussions between several experts, for additional parameters required for the transmission of AWS, and also for templates for AWS. Significant contributions were also provided byDr Igor Zahumensky (Slovakia), Mr Dick Blaauboer (Netherlands), Mr Michel Leroy (France), Mr Jeff Ator (US), Dr Miroslav Ondras (Slovakia), Mr Chris Long (UK), Mr Milan Dragosavac (ECMWF) and Mr Klaus Schulze (WMO). The validation of these templates had been made by data exchanges using Opera EUMETNET software and Slovak MPS software. The templates will be presented as recommendation of this Team to the Meeting of the ET on AWS in September 2002, for subsequent inclusion in Attachment to Volume I.2.(see Annex to this paragraph). The Team agreed to recommend to CBS the additional descriptors with a view to their operational implementation in November 2003.

3.2 APPROVAL OF COMMON SEQUENCES AND TEMPLATES IN BUFR/CREX FOR RELEVANT CHARACTER CODES

3.2.1 Templates proposed for traditional observations were reviewed again before their inclusion in the Manual on Codes. The Team expressed the opinion that the migration would be easier if only the elements having direct counterparts in the traditional codes were included. Taking advantage of the TDCF, metadata will also be included. Additional descriptors have been included in the templates, like, for example, the descriptor 0 01 011 (Mobile land station identifier) has been added into the SYNOP template to make it suitable also for the SYNOP MOBIL (see Annex to this paragraph). The templates will be presented as recommendation to CBS for subsequent inclusion in Attachment to Volume I.2. The

Team agreed to recommend to CBS the additional descriptors with a view to their operational implementation in November 2003.

3.2.2 At the first session of ET/MTDCF, Geneva, 7-11 May 2001, a preliminary migration plan was elaborated. Traditional code forms were grouped into six categories which were thought to share common characteristic which would allow migration to proceed in parallel. For each of these categories three target dates were set, the start of experimental exchange, the start of operational exchange and the end of operational exchange. CLIMAT, CLIMAT SHIP, CLIMAT TEMP and CLIMAT TEMP SHIP code forms were also put into the first category (the common code forms) with the start of experimental exchange in November 2003. The BUFR templates for these code forms had been defined by Dr Eva Cervena (see Annex to this paragraph).

3.2.2.1 New descriptors needed in BUFR templates for the CLIMAT codes.

According to the Guide to Climatological Practices, the monthly mean air temperature is reported as a true mean or corrected value to correspond to a mean based on 24 direct observations a day. The mean of four equally spaced observations may suffice as a close approximation to the true mean. Some countries have notified using eight equally spaced observations a day for this purpose. A new descriptor is, however, needed for standard deviation of daily mean values of temperature (relative to the monthly mean air temperature) which is required in the CLIMAT report. The existing descriptor 0 12 051 (standard deviation temperature) was not suitable to express it. "Mean daily maximum temperature" and "Mean daily minimum temperature" reported in CLIMAT, cannot be represented as a mean value of 0 12 116 (Maximum temperature at 2 m, past 24 hours) and 0 12 117 (Minimum temperature at 2 m, past 24 hours), respectively, if specification of the height of thermometer above local ground is to be included in the BUFR template for CLIMAT data. In any case, principal time of daily reading of maximum and minimum extreme temperatures is required to be reported. The existing entry 3 (Extreme temperature) of the code table 0 08 051 (Qualifier for number of missing values in calculation of statistic) is not capable to represent the required number of days missing from the record of daily maximum temperature and separately number of days missing from the record of daily minimum temperature. Moreover another code figure is needed to express "Wind", required in CLIMAT TEMP and CLIMAT TEMP SHIP data. A code table 1400 is used in the CLIMAT TEMP and CLIMAT TEMP SHIP code forms to express time of observation used to compute the reported mean values of geopotencial, temperature and humidity. A flag table has been defined for this purpose. The additional table entries and code table are defined in Annex to paragraph 3.2.2.

3.2.2.2 The Team recommended that CBS consult CCl for the contents of the templates for CLIMAT TEMP and CLIMAT TEMP SHIP, while more validation should be pursued by the team.

3.2.3 Mr Fred Branski, the Chairman of the ET/MTDCF, expressed his appreciation to the members of the ET/DR&C for their work to provide previously unavailable BUFR templates and improvements to those already in development for traditional observations. Especially notable was the work by Dr Eva Cervena (Czech Republic) for the new templates for CLIMAT codes.

3.2.4 Application Program Interface (API)

The Team recommended that development of standard API be considered by the ET/MTDCF, to interface with BUFR templates.

3.2.5 Dutch proposal regarding use of delayed replication for BUFR encoded messages to handle many missing values

The Expert Team expressed appreciation for the proposal submitted by Mr Jaap van der Plank and Mr Dick Blaauboer regarding the use of delayed replication within BUFR templates to handle many missing values within a set of data resulting from differing reporting requirements. This method had merit and should be considered by encoders keeping in mind how it could affect the ability to use compression. The team did not feel there was a need to include it within any existing templates at this time but would consider it for future use if a need arose. The team also stated that it should be informed if there was a specific case where a standard template using this technique was needed to support operational data exchange.

3.3 APPROVAL OF NEW ENTRIES IN BUFR TABLE D FOR EXCHANGING GEOSTATIONARY SATELLITE RADIANCE DATA

A project has been ongoing between NOAA/NESDIS, ECMWF, EUMETSAT and the University of Wisconsin, among others, to exchange enhanced geostationary satellite radiance data in BUFR, and it was requested to assign revised BUFR Table D descriptors to the sequences of descriptors being exchanged. The Team approved for pre-operation the additional sequences found in Annex to this paragraph.

3.4 TRANSMISSION OF ENSEMBLE TROPICAL CYCLONE TRACKS IN BUFR

3.4.1 The Team thanked Mr Atsushi Shimazaki for his excellent work in the design of a template for the transmission of tropical cyclone track and information output of Ensemble Prediction Systems (EPS). The ET on EPS (ET/EPS) had agreed that FM 94 BUFR could be used for exchange of tropical storm tracks from EPS members while it considered FM 92 GRIB Edition 2 the most practical code for exchange of gridded EPS data. The ET/EPS requested the ET/DR&C to finalize common sequences in BUFR Tables for that purpose. An original template was developed by JMA and circulated to the Members of ET/EPS for examination with a view to submitting it to the meeting of the ET/DR&C. A template, descriptors and required associated tables, which were based on the comments of the Members of ET/EPS had been proposed. A validation test for the template and associated descriptors and tables is planned by ET/EPS. ECMWF and JMA indicated that they will participate in the test to be completed by September 2002. The result of the test will be reported to the ET/DR&C by JMA.

3.4.2 The Team agreed to the proposed template of FM94 BUFR for Tropical Cyclone Information derived from EPS as shown in Annex to this paragraph. The Team agreed to including it in the Attachment to BUFR of Manual on Codes, Volume I.2. Proposed descriptors and associated code tables involved in the template are shown in the Annex to this paragraph. The Team recommended them for pre-operational implementation.

3.5 OTHER ADDITIONS TO BUFR/CREX

3.5.1 Additions for AMDAR

3.5.1.1 The data requirements for AMDAR were fully described in the AMDAR Reference Manual (an AMDAR Panel document to be published in 2002). The current sequence BUFR descriptors could not be used efficiently to disseminate AMDAR data and some new data descriptors needed to be defined.

3.5.1.2 A revised AMDAR template is proposed in Annex to this paragraph with new BUFR descriptors as necessary to meet the anticipated needs of processing Centres and local forecast offices respectively. There are a new sequence for a standard AMDAR message and a sequence for each level for a simplified AMDAR sounding.

3.5.1.3 A need has been expressed for AMDAR data to be encoded in simple 'single sounding' format to meet local needs at aerodromes in data sparse areas. As normally circulated, each AMDAR report is a single level message not well suited to local processing, especially to produce vertical profiles of the atmosphere along the lines of a radio-sonde sounding. A proposed AMDAR profile template is given in Table 5. As for a radio-sonde sounding, the position and time of each level is omitted. The position, date and time is taken as the lowest level available for the sounding. This will be the first level in the case of an ascent and the last level in the case of a descent. The phase of flight descriptor is convenient to identify ascent or descent profiles. Strictly, this descriptor applies to a single observation only but used here it is unambiguous. These profiles can be produced only by data processing centres that retain databases of AMDAR reports. The CREX format for GTS encoding is recommended to make these data of immediate value for meteorological services that do not process BUFR messages.

3.5.1.4 Code validation: Before introduction to general use it will be necessary to validate the code in an operational environment. The sources of data are all the current AMDAR downlink formats. However, there are many different formats in use, some of which are not accessible to meteorological centres. In the case of ASDAR, GTS encoding is done at the satellite ground stations and subsequent BUFR

encoding is only possible using FM 42 as the data source. ADS data are received at the WAFCs. In principle these data are unchanged from the original source (aircraft generated) format. Further encoding of ADS reports is the responsibility of the WAFCs. In the USA encoding of most raw AMDAR data is carried out by ARINC (the communication service provider) prior to reception at NCEP. In Europe some encoding is done by national meteorological centres but a particularly comprehensive system is operated by the EUMETNET AMDAR (E-AMDAR) programme. The E-AMDAR system is ideally placed to test new BUFR templates and has the technical capability for off-line and pre-operational end to end validation. A similar service might be available from the Australian Bureau of Meteorology that has a well-developed AMDAR processing system. In view of the above considerations, the Team recommended that the AMDAR Panel co-ordinates further validation of AMDAR BUFR and CREX encoding.

3.5.1.5 Operational Implementation: Some processing Centres will be ready to produce AMDAR data in BUFR in the new template during 2002. The Team therefore recommended use of scale 2 for temperature and accepted a pre-validated set of entries with a view for pre-operational experimental implementation from 6 November 2002. The CBS will then be asked to endorse the BUFR/CREX additions for full operational implementation in November 2003.

3.5.2 Addition to Class 35 (Data monitoring information)

The Team agreed for pre-operational implementation to the addition requested by USA of two new Class 35 BUFR/CREX descriptors which would enable improved bulletin monitoring (see annex to this paragraph).

3.5.3 New Common Table C-11 for Originating Centres

The migration to TDCF will require one Originating Centre by country. Presently, some countries have more than one originating Centre and other would not be able to be attributed an entry because of lack of entries available for their WMO region. The Team therefore recommended the addition of a note to the present Common Table C-1 to allow for overflow from one region to another if necessary. At the same time the Team recommended for pre-operational implementation a new CommonTable C-11 with 16 bits to be used by GRIB 2 and CREX. The proposals are listed in Annex to this paragraph.

3.5.4 New Table B descriptors for use with AMSU A/B satellite data

The Team agreed to recommend for pre-operational implementation two new BUFR/CREX Table B descriptors requested by USA for use in reporting certain types of AMSU A/B satellite data. The descriptors are found in Annex to this paragraph.

3.5.5 Addition to a regulation on replication operation in BUFR

The Team agreed to an editorial addition proposed by JMA to clarify the counting of descriptors in nested replications. In order to ensure a correct understanding of the replication operation, especially in case of nesting, it recommended to add a note to regulation 94.5.4.1 (see Annex to this paragraph). The Team recommended that this addition should also be reflected in the Guide to BUFR.

3.5.6 New Table B descriptors for use with next generation Rawinsonde data

3.5.6.1 The U.S. National Weather Service is planning to introduce a new network of revamped rawinsondes within the next year, under a project known as the “Radiosonde Replacement System (RRS)”. These rawinsondes will be equipped with GPS locators allowing a precise latitude and longitude to be measured at every data point during the sounding flight as well as some of the most technologically-advanced sensing equipment for temperature, moisture, etc. that are available today. In addition, enhanced processing software is being developed to encode this high-resolution data into BUFR, both for GTS exchange as well as for national long-term archiving purposes. The plan is to begin producing test archive data sets within the coming year, followed soon thereafter by the introduction of high-resolution BUFR data sets onto the GTS for international exchange, although it should be noted that alphanumeric TEMP and PILOT messages will also be produced from this data in order to allow continued international exchange with those Centers which will not yet be able to handle the enhanced-resolution

BUFR products.

3.5.6.2 The Team agreed that some of the requested new descriptors (see Annex to this paragraph) needed further validation, but in principle the whole set was recommended for pre-operational implementation, as soon as validation would be confirmed. Although there were no plans within the USA to make use of any of the corresponding CREX versions of these descriptors, USA nonetheless felt that the CREX counterparts for these descriptors could be useful in case other Centers might eventually wish to exchange such information in CREX.

3.5.7 Coding of Volcanic ash information

Amendment 72 to ICAO Annex 3, WMO Technical Regulation - [C.3.1] – Meteorological Service for International Air Navigation recommends that Meteorological watch offices in a position to do so should issue SIGMET information for volcanic ash cloud and tropical cyclones in graphical format using the WMO BUFR code. Australia proposed BUFR table additions required to issue SIGMET messages for volcanic ash cloud in the BUFR code form. If the BUFR descriptors were carefully chosen, it should be possible to extend the encoding of Volcanic Ash SIGMET to other SIGMET. Although not strictly necessary, the encoding of Volcanic Ash SIGMET in BUFR would be simplified if sequence descriptors were defined for major parts of the message. The Team agreed to the set of additions to BUFR as listed in Annex to this paragraph and recommended it for pre-operational implementation.

3.5.8 Descriptor for use in reporting certain types of AIRS satellite data

The Team agreed to a new descriptor for use in reporting certain types of AIRS satellite data and recommended it for pre-operational implementation (see Annex to this paragraph).

3.5.9 Additional entries in BUFR code tables to support JASON satellite data

The JASON satellite had been launched in December 2001. The measurements made by this spacecraft had large potential for use both in meteorology and oceanography fields. To support distribution of an associated near real-time product on the GTS from next autumn, France proposed extra entries in BUFR code tables. The Team agreed that some of the requested new descriptors (see Annex to this paragraph) needed further validation, but in principle the whole set was recommended for pre-operational implementation, as soon as validation would be confirmed.

3.6 PROPOSED ADDITIONS FOR A NEW EDITION

3.6.1 Representation of Probabilities and other Forecast Data within BUFR/CREX

A division within the U.S. National Weather Service has been generating forecast model output statistics for some time now. Since, one could consider that the basic layout of this data consists of various parameters valid at the same data point (i.e. forecast site), rather than one single parameter valid at many various data points, the choice of BUFR was appropriate. The USA also foresaw the possibility that other organizations might ultimately find it useful and practical to distribute their own forecast or other model output data in this way. The Team agreed that the descriptors defined in Annex to this paragraph would be part of a new edition to be put for recommendation to CBS 2004, together with all other needed entries making a new edition of BUFR/CREX for operational implementation in November 2005. Meanwhile, the team agreed that these entries be recorded as allocated.

3.6.2 New operator within BUFR Table C to simplify the procedure of increasing descriptor precision

When it is desired to increase the precision of a BUFR Table B descriptor, the Table C operator 2-02-Y is used to indicate the new scale factor to be used when encoding the actual value into BUFR. However, the use of this operator often necessitates corresponding changes to the reference value (when non-zero) and bit width of the Table B descriptor in question, in order to be able to represent the same range of actual values with the new precision. To simplify the complexity of the transformation, USA is proposing a new BUFR Table C operator which would effect an increase of scale in the same manner as 2-02-Y, except that it would also automatically effect a corresponding increase of scale to the associated reference value, and thereby obviate the need to define the new reference value using the additional (and

more complex!) 2-03-Y operator. Taken one step further, since, again, a corresponding increase of bit width is usually also necessary when increasing a scale, this new operator could also be made to automatically effect a sufficient bit width increase based upon the desired increase of scale, so that this one new operator then accomplishes the same amount of work that currently requires the separate use of all three operators 2-01-Y, 2-02-Y, and 2-03-Y. Since the main goal of this proposal is, again, to simplify the changing of reference values that often accompanies an increase in scale, and since CREX does not even make use of reference values, there should be no need to add a corresponding new operator to CREX Table C. The Team agreed that the new operator descriptor defined in Annex to this paragraph would be part of a new edition to be put for recommendation to CBS 2004, together with all other needed entries making a new edition of BUFR/CREX for operational implementation in November 2005. Meanwhile, the team agreed that this entry be recorded as allocated.

3.6.3 New operator within BUFR Table C changing data width for CCITT IA5 elements

USA requested a new operator within BUFR Table C which would permit the changing of data widths for CCITT IA5 elements within BUFR Table B. The Team agreed that the new operator descriptor defined in Annex to this paragraph would be part of a new edition to be put for recommendation to CBS 2004, together with all other needed entries making a new edition of BUFR/CREX for operational implementation in November 2005. Meanwhile, the team agreed that this entry be recorded as allocated.

3.7 EXPERIMENTAL EXCHANGE OF OBSERVATIONS IN BUFR/CREX

3.7.1 USA indicated that they could make available on the GTS BUFR encoded rawindsonde data. They will make the list of stations available.

3.7.2 JMA is transmitting wind profiler data in BUFR (about 20 stations)

3.7.3 Ms Eva Cervena reported on the EUMETNET pilot project. It was planned to start in December 2002 to exchange hourly observations from both automated and manned stations in BUFR. Five countries were involved : Czech Republic, Germany, France, Netherlands and Slovakia. The EUMETNET OPERA software will be refined during summer 2002.

3.7.4 Ozone data are exchanged in CREX as well as soil temperature data.

4. MODIFICATIONS TO TRADITIONAL ALPHANUMERIC CODES

4.1 THE REQUIREMENTS FOR REPORTING PRECIPITATION AND ITS GLOBAL HARMONIZATION

The requirements for global harmonization of reporting precipitation had been expressed by the Expert Team on Surface Data Quality Monitoring and by CBS XII. CBS XII had invited the ET/DR&C to revise the procedures with a view to mandatory reporting of 24 hour precipitation and reporting zero measured precipitation as zero in the code as recommended by the Expert Team on Surface Data Quality Monitoring. To address shortcomings identified in accounting for correct accumulation of precipitation amounts reported over a 24 hour period, the ET/DR&C considered changes to the FM 12 regulations and recommended that all WMO Regional Associations be approached to put their regional (and national) procedures in line with the requirements expressed by the Commission. On this ground, the Team recommended the modifications to FM 12, FM 13 and FM 14 regulations as listed in the Annex to this paragraph for approval by CBS for implementation on 5 November 2003.

4.2 MODIFICATIONS TO AERONAUTICAL METEOROLOGICAL CODES

4.2.1 The representative of ICAO presented the modifications that will be necessary to aeronautical meteorological codes as a result of Amendments 72 and 73 to Annex 3. The amendments are listed in the Annex to this paragraph, together with a brief explanation of the reasons for the amendments. It was noted that most of the amendments were related to the upcoming Amendment 73 to Annex 3 and were therefore still subject to the standard consultation process and adoption by the ICAO Council. However, in view of the considerable time needed for the implementation of code changes, it was considered

important that a parallel amendment to the *Manual on Codes* (WMO — No. 306) be prepared well in advance before the expected applicability date.

4.2.2. A pending amendment to the Manual on Codes:

4.2.2.1 The Team was aware that, at the request of ICAO, the proposed changes to paragraphs 15.1.1 and 51.1 included in the recent draft amendment to the *Manual on Codes* (WMO — No. 306) were postponed *sine die*, a few weeks before the applicability date. This was due to the fact that the amendment which was primarily intended to make the inclusion of the code names METAR, SPECI and TAF mandatory in each report and forecast (for which there is a genuine aeronautical requirement in the data-link environment) would also had made mandatory the inclusion of the line in meteorological bulletins immediately following the WMO abbreviated header. The ICAO Meteorological Group (METG) of the European Air Navigation Planning Group (EANPG) felt that if that line were made mandatory, serious operational problems with the management of meteorological bulletins would occur.

4.2.2.2 The issue had since been considered by the EANPG, which in its Conclusion 43/31 called for "ICAO to bring to the attention of WMO the need for amendment of the bulletin code format for METAR, SPECI and TAF in order to delete redundant information and to make the bulletin formats for METAR, SPECI and TAF codes consistent". To meet the intent of this conclusion, it could be postulated that there was no *raison d'être* any longer for the additional line following the WMO abbreviated bulletin header in any bulletin; according to Annex 3/Technical Regulations (C.3.1) both the code name and time group included on that line were compulsory in each individual METAR/SPECI report and TAF forecast — no matter whether they were in a bulletin or not. The corresponding draft amendment to provisions 15.1.1 and 51.1.1 which would render the additional line redundant had been developed and was included in the appendix to paragraph 4.2.1.

4.2.2.3. Applicability dates:

The Team agreed that, in order to ensure a coordinated implementation, the dates for implementation of amendments to the aeronautical codes be conditioned by operational constraints rather than administrative procedures and be simultaneous with the dates of implementation of all code changes recommended by CBS. The Team recommended these last modifications to aeronautical codes to be implemented on the first Wednesday following the 1 November 2004.

4.2.3 The use of the BUFR code form for aeronautical meteorological data:

The Team was reminded that an enabling clause had been included in Annex 3/Technical Regulations (C.3.1) to use the BUFR code form for graphical SIGMETs for tropical cyclones and volcanic ash (Amendment 72). Furthermore, similar clauses had been incorporated in draft Amendment 73 which would allow the use of the BUFR code form for METAR and SPECI reports and TAF forecasts. In the long term, it is expected that the terms METAR, SPECI and TAF would no longer refer to a code form, they would be templates showing how the information is to be presented to aeronautical users. It was understood that encoding and decoding software still had to be developed. In that context, also the BUFR code tables may have to be amended to accommodate these new messages. No immediate action by the Team was required from ICAO; however, the Team appreciated to be made aware of the issue at this early stage.

4.2.4 Use by USA of turbulence and icing groups in FM 51 TAF

The Team was informed by Mr Jeff Ator that U.S.A was continuing to make use of the previously-deleted turbulence and icing code groups $(5BhBhBhBtL)$ and $(6IchihihitL)$ in FM 51 TAF and would officially file a national deviation for that practice to be inserted in Volume II.

4.2.5 Need for amendments to the AUTO METAR

The Team was informed of the intention of France to propose through ICAO amendments to the AUTO METAR to specify that some reported information have inherent loopholes due to the limitation of Automated observations. For example, there are the following limitations. Most of the time, the visibility transmitted in the AUTO METAR is at a single location which is the location of the sensor; therefore, it is

not “representative of the aerodrome and its vicinity”; moreover, the directional variations cannot then be detected nor transmitted. The cloud information takes into account all the cloud layers that have passed above the ceilometer, but this cloud information is incomplete because the system cannot recognise the type of cloud; as a consequence, specific information about CB and TCU cannot be reported in AUTO METAR although cloud indications can be available. Moreover, for the time being, when no clouds are detected by the ceilometer, the abbreviation NSC is transmitted. According to the rule 15.4 in FM15 METAR format, related to code word (AUTO), if any element cannot be observed in AUTO METAR, the group in which it would have been encoded shall be replaced by the appropriate number of solidi. And the note (2) says that omitting a group in a METAR means that the corresponding phenomenon does not occur.

4.2.5.1 There could be a situation where:

- a phenomenon of operational significance for aviation users does occur,

- existence of clouds is indicated in the message, which implies, in particular, that clouds of operational significance could be reported; but no possibility is offered by the code to specify that it was not possible to report these.

4.2.5.2 Due to the fact that only a partial cloud information is and can be available with the present format of the message, the current format may mislead the user, if he/she is not perfectly informed of and/or does not precisely remember the limitations of the AUTO METAR. It is necessary to indicate in the message, at the location where the AUTO METAR was elaborated, and when the observation of CB and TCU is impossible. Moreover, the meaning of NSC is slightly different in AUTO METAR and in METAR. NSC in AUTO METAR means that no cloud has been detected by the ceilometer. For these two parameters, it seems necessary to explicitly make the distinction between “no possibility to observe the phenomenon” and “observation made but phenomenon not observed”. This need will be increased when automatic means will allow to determine the visibility representative of the aerodrome in some location, or will allow CB and TCU automatic detection that could be included in the AUTO METAR.

4.3 CORRECT ENCODING OF FM71 CLIMAT AND FM75 CLIMAT TEMP

4.3.1 The Expert from Japan, Mr Atsushi Shimazaki pointed to the necessity of a proper Guide for the coding of FM 71 CLIMAT and FM 75 CLIMAT TEMP reports. The CCl-XIII considered how it should proceed with Part II of the new Guide to Climatological Practices, which includes coding practice for CLIMAT and CLIMAT TEMP and recognized that a starting point would be a review of the requirements and associated costs of that part of the Guide. Considering that the Guide has played an important role to reduce the erroneous data in CLIMAT and CLIMAT TEMP, the Team recommended that CBS requests CCL that Part II of the Guide be finalized earlier.

4.3.2 Concerning the levels reported in CLIMAT TEMP, it was noted that the levels to be reported were defined as follows:

> 75.4 The monthly mean values of the upper-level element shall include information for station level and for the isobaric surfaces of 850, 700, 500, 300, 200, 150, 100, 50 and 30 hPa, if available.

According to this regulation, omission of all data groups on a level on which all elements were not available seems to be allowed. However, since CLIMAT TEMP had neither indicator figures nor figure groups, one could not identify a data group without information on the location of the group in the report, omission of data groups on a level, especially for a station level which consists of two groups, would cause problems in data processing. The Team recommended then the addition of a sentence to the regulation 75.4 stating that solidi shall be reported for any missing value. This will be submitted to CBS. The addition is listed in annex to this paragraph.

5. PRODUCTION OF A GUIDE TO GRIB EDITION 2

The Expert Teams on DR&C (Toulouse, 23-27 April 2001) and on MTDCF (Geneva, 7-11 May 2001) had

recommended the urgent production by a consultant of a Guide to GRIB Edition 2. The last Executive Council emphasized the need for training to prepare the NMHSs in time for the use of GRIB 2 (paragraph 3.1.20). The production of the Guide to GRIB Edition 2 was a fundamental element of training guidance for the NMHSs. The Guide to GRIB Edition 2, once written, would have to be reviewed by the ET/DR&C.

5.1. The Team recommended that the Guide to GRIB Edition 2 be layered in three parts as for the Guide on BUFR/CREX. The guide will be prepared to assist experts who wish to understand or use the WMO Code Form FM 92 GRIB Edition 2. The guide should comprise three layers to accommodate users who require different levels of understanding.

5.1.1 Layer 1 should be a general description designed for those who need to become familiar with the table/template driven code form but do not need a detailed understanding. It should introduce the concept of template. And it should explain how the GRIB 2 layout is structured, and how it can be expanded for new type of grid or parameter to be exchanged.

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5.1.2 Layer 2 should focus on the functionality and application of GRIB 2, and should be intended for those who must use software that encodes and/or decodes GRIB 2, in particular those who wants to produce fields in GRIB 2 format with an encoder, but will not actually write the software. or similarly those who will receive fields transmitted in GRIB 2 format and decoded by an available GRIB 2 decoder software.

5.1.3 Layer 3 will be intended for those who must actually write GRIB 2 encoding and/or decoding software, although those wishing to study table/template driven code in depth, will find it equally useful.

5.2. The Team estimated the production of the Guide to require at least two months of work. The Team recognized the urgency of this task and recommended the WMO Secretariat to hire a consultant. One week should be spent first by the consultant in the WMO Secretariat to collect all necessary material, clarify and agree on the structure and contents of the Guide.

5.3 The Team recommended that Guides to WMO representation forms (BUFR/CREX, GRIB) be similarly reviewed, appropriate updates defined and that this subject made as a permanent item in the agenda of the Team.

6. USE OF XML FOR TRANSMITTING METEOROLOGICAL INFORMATION

The Team discussed the document written by Mr Charles Sanders and other authors on the use of XML to exchange meteorological information. The Team thanked Mr Sanders for the heavy work he put to compile this information. Use of XML was rapidly expanding, but WMO has not as yet taken a leading role in developing XML standards for meteorological information. The document analyzed the present use of XML in Meteorology and tried to propose options for WMO actions with a view to recommend a WMO standard for the exchange of data and metadata in XML.

6.1 The document listed some strategic options for WMO:

- The broad, overall policy on whether to follow the crowd, or to be a lead player in the development of XML.
- Whether to adopt an English-based XML vocabulary, or try to develop a more “international” standard.
- Whether to develop a small set of general-purpose XML schemas, or a larger set of more specialised schemas.
- Whether to create or adopt a very rigid XML standard, or to opt for a more generalised and flexible standard.

6.2 The Team considered the task very difficult because it was asked to find a solution to a problem of which the parameters where not well defined. The requirements were not universal and presently individual ad-hoc solutions had been developed, risking the complication of the future tasks and data exchanges if no agreed international standards were developed.

6.2.1 The Team tried first to list the areas where there could be a need to use XML. It admitted that the

inherent verbose characteristic of XML was making it unfit to translate bulky data such as satellite, GRIB or large number of BUFR encoded observations. Manipulating GRIB or BUFR data in XML would be possible only in considering the GRIB or BUFR file as objects of the XML data set.

6.2.2 It was agreed that a use of XML in meteorology would be to exchange limited number of observations. This would be done at the beginning in the INTERNET environment. This would be most appropriate to interface, first with users, external to the NMHS.

6.2.3 XML could also be used to pass information like METNO or forecast information or warning, etc… Those features for which there was no existing operational WMO standards, are well fit for XML format, and are often exchanged via INTERNET.

6.2.4 XML could also be used to exchange documents. An immediate example would be the Manual on Codes itself.

6.2.5 Another use of XML could be for an alternative mean of collection of observations at national levels or even for international exchanges in case there was no appropriate GTS link.

6.2.6 Finally, the Team agreed that XML could be used for describing metadata of WMO exchanged files. The Team was informed of the current work of the ET on Integrated Data Management who was defining the standards for the Metadata in XML format. The Team wished to be kept aware of the results of this work.

6.3 To standardize the exchange of observations in XML, the Team agreed that a simple immediate solution would be to use as standard tags the number of BUFR/CREX descriptors which make an exhaustive list of parameters to be possibly exchanged in the operational meteorology. The name of the parameters could be used as attribute and the representation in CREX could define the number of figures and digits after the dot (scale and width). The names of the descriptors in the four official languages of WMO would solve the international language issue. The use of such standard for XML would simplify the translation into or from CREX or BUFR; although it is not simple to write the program interfacing with the XML encoder, the encoder being an existing off-the-shelf package. It would be neither simple to use the output of an XML parser (existing off-the-shelf package) into a meteorological processing application (e.g. data bases, telecommunications),. With those standards tags, standard XML schemas for all meteorological observations could be easily defined. With such an internationally agreed standard, the exchange of simple observations in XML would be make easy between WMO Members. The definition of a WMO XML standard would help to prevent the development of meteorological standards outside the WMO circle. Such externally developed standards might not fit WMO requirements and could be difficult to use.

6.4 The Team agreed that these recommendations should be clearly transmitted to the ET on Integrated Data Management.

6.5 Any WMO defined standard for the use of XML in meteorology is unlikely to meet all needs. Mechanism to allow additions or alterations to the standard for internal, bilateral, or multilateral basis will have to be implemented as for other current WMO standards.

6.6 The Team considered that the operational use of XML would have an impact in data representation, data management and telecommunications, and that all WMO concerned Expert Teams should examine the problem and the possible implications on their standards and protocols.

6.7 The Team finally recommended that CBS organised a workshop on the use of XML in meteorology to further elaborate on requirements, problems and solutions.

7. MANUAL ON CODES

7.1 IMPLEMENTATION OF THE PROCEDURES FOR MODIFICATIONS TO TABLE DRIVEN CODES

7.1.1 The Team took note of the validation procedures recommended by CBS XII for the modifications

to the Manual on Codes and would ensure that they will be followed. The Team expressed concern on the practical delay of six months between the approbation of a modification and its possible implementation. The Team understood that the delay of 3 months, in addition to the 3 months required to notify the WMO Members, was due to the publication work for the production of the hard-copy of the Manual. The Team stressed, as said already in previous meetings, that a Master copy of the Manual kept on the WMO Web server would greatly reduce the delays, and asked the Secretariat to study this possibility.

7.1.2 The Team noted with appreciation that the CBS Management Group (CBS-MG) had requested the nomination of national focal points for Matters relative to WMO Codes and Data Representations including the Migration to TDCF. The Team asked the Secretariat that the focal points will be informed quickly of the codes changes recommended by the ET/DR&C.

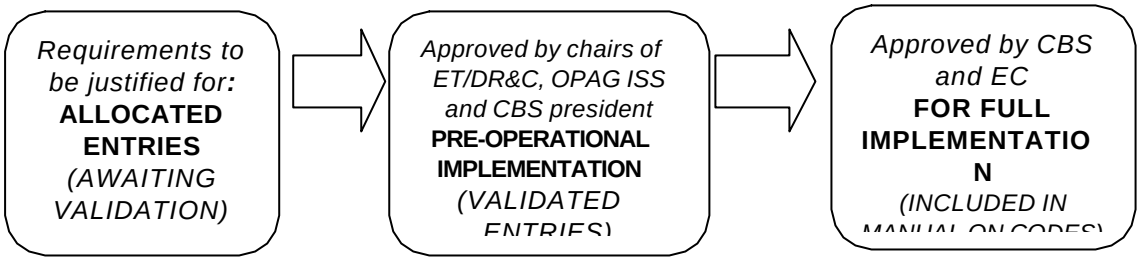
7.1.3 The CBS-MG noted that the fast-track mechanism should be reserved for urgent operational problems. The MG agreed that fast-track requests should be accompanied by documentation justifying the urgency of the requirement. The majority of changes to the codes and code tables should follow normal procedures, i.e. should be submitted for approval by EC no later than February with later submissions being deferred to the following year. Recognizing that applying this process to all updates to the code tables would seriously delay their implementation, the CBS-MG agreed that a two step process should be used. The CBS-MG said that Table changes would first be approved for experimental use by the president of CBS and would be made available as a digital file (i.e. not published in printed form), then once they had been used experimentally for one year they could be submitted for official adoption through existing formal procedures. The CBS-MG requested the ET/DR&C to further develop these ideas and present a proposal to the CBS president.

7.1.4 The Team expressed concern that the current adoption of BUFR/CREX/GRIB code table updates would be made even slower. Moreover, the yearly frequency is not adequate to accommodate all needs, especially those related to satellite data. It was pointed out that with the current procedures, some data were already distributed with local descriptors, and that any additional delays would lead to a proliferation of such local entries. This would not serve the WMO community.

7.1.5 A new mechanism was proposed, with a view to accommodate both CBS-MG issues and user needs. The Procedure proposed is as follows:

- (as already in use,) requests for new descriptors are submitted to the WMO Secretariat, with source and justification of the requirements
- such requests (still) need to be justified, with listing the scientific, technical and/or operational requirements, as well as target dates for effective use
- these requests are dealt with by ET/DR&C in session or via correspondence, who allocates available table entries
- the proposal is submitted for information to the requesting source, focal points on code matters, Chairperson of OPAG-ISS and president of CBS, through e-mail and posted on WMO web server
- associated documents kept on WMO web server will include associated pairs: a first document to record the request, the second one for descriptors themselves, target validation date and target operational date
- these table entries are reviewed at least twice a year and will be in one of three stages reflected in 3 different list or tables:
  - not yet fully validated, that is partially validated
  - declared fully validated and pre-operational, awaiting official approval
  - approved by CBS and EC. These Table Entries will then appear in the Manual on Codes
- there are two groups of Codes Changes:
  - "simple" additional entries that do not require software changes.
  - more complex changes that do require software changes (and the making of a new edition) and that need more extensive analysis and review. These will be reviewed by the ET/DR&C in session and submitted to CBS each second year for approval.
- the validation procedures as defined in the introduction to the Manual on Codes shall always be applied.

IMPLEMENTATION PROCEDURES FOR ADDITIONS OF DESCRIPTORS IN BUFR/CREX TABLES A, B AND D, AND NEW GRIB TEMPLATES -- TABLES LISTED IN WMO WEB SERVER



7.2 PROPOSED MANUAL ON REPORTING PRACTICES

7.2.1. It is a fact that the Manual on Codes, Volume I.1, contains more regulations related to reporting practices than formatting rules. The Volume I.2, on the contrary defines formatting systems, and practically no reporting regulations. The Volume I.1 links reporting practices to the alphanumeric coding format. The migration to BUFR/CREX will push producers and users (human decoders) of BUFR/CREX codes to consider Volume I.2, rather than Volume I.1. It is necessary to re-write the regulations on reporting practices, disconnecting them from the traditional alphanumeric format, and making them "universal", to fit, for instance, various national Automatic Weather Station templates which would be used to report the so-called "surface synoptic observations" in BUFR. It would make the migration to TDCF easier for the programmers of automatic platform software, for the meteorologists and the observers.

7.2.2 The Team noted that reporting requirements as well as observing practices were currently included along with the data representation formats for the traditional code forms. It agreed these requirements and practices should be separated from the data representation and recommends placing them in an Annex to Volume 1.2.

7.2.3. The Team agreed on the difficulty of this task. The work will require the service of a consultant for perhaps three weeks. The Team recommended this activity to be performed under the responsibility of the WMO Secretariat. The new Annex on reporting practices, once written, will have to be reviewed by appropriate Teams of CBS.

8. ACTIONS PLAN

8.1 NEXT MEETING: The Rapporteur on Codes for RA I, Mr Scylla SILLAYO from Tanzania, transmitted the invitation of Dr Mhita, Permanent Representative of Tanzania with WMO and President of RA I , to hold the next meeting of the ET/DR&C in Tanzania, followed by a Training Seminar on Data Representation for RA I , where experts of the Team could lecture. The Team welcomed the initiative and thanked Dr Mhita for his invitation. The Team agreed that this will be an opportunity to help in bridging a bit the technological gap, and asked the Secretariat to organize the next Meeting in Tanzania in 2003. Mr Sillayo suggested to hold the Meeting in January 2003.

8.2 TASKS:

- ECMWF and NCEP to validate PDTs 4.9 and 4.10 (2.1.1)
- Secretariat to check requirements and validation for GDTs 3.1000/1100/1200 and PDTs 4.1000/1001/1100/1101 (2.1.2).
- Approach Telecommunications ET to raise GTS limit to 100K bytes *(250 K bytes requested by ET/MTDCF)* (Secretariat) (2.2.3)
- JMA, NCEP and ECMWF to validate EPS PDTs (2.4.1)
- Consult CCl for Template of CLIMATs reports in BUFR (Secretariat) (3.2.2.2)
- Team members to validate CLIMATs templates (3.2.2.2)
- ECMWF and JMA to validate by September 2002 template of EPS Tropical Cyclone Tracks in BUFR (3.4.1)
- Use of AMDAR profile template for GTS encoding (AMDAR processing Centres) (3.5.1.3)
- Validation of AMDAR Templates through AMDAR Panel (3.5.1.4)
- USA to organize validation of new Templates for new radiosondes reports in BUFR (3.5.6.2)
- Validation of new JASON descriptors (France, ECMWF?; EUMETSAT?) (3.5.9)

- USA to make available new encoded rawindsonde BUFR data on GTS (3.7.1)
- Exhange of hourly automated station reports starting December 2002 (Five EUMETNET countries) (3.7.3)
- USA to file deviation for turbulence and icing groups (4.2.4)
- CBS to request CCL to complete new guide on CLIMAT reports encoding (Secretariat) (4.3.1)
- Secretariat to hire consultant for Guide on GRIB 2 (5.2)
- Guide made a permanent item of the ET/DR&C Agenda (Secretariat) (5.3).
- The Team informed of results on Metadata in XML (Secretariat) (6.2.6)
- Recommendations passed to ET on IDM (Secretariat) (6.4)
- All expert teams to consider impact of XML exchange (Secretariat) (6.6)
- Organisation of a workshop on XML (Secretariat) (6.7)
- Master copy of manual on line (Secretariat) (7.1.1)
- Inform focal points of proposed code changes (Secretariat) (7.1.2)
- Secretariat to implement new pre-operational implementation procedure (7.1.5)
- Consultant to be hired for new reporting practices (Secretariat) (7.2.3)

9. CLOSURE OF THE MEETING

The Meeting was closed by the Chairman of the ET/DR&C at 17.00 on Friday 26 April 2002.

ANNEX TO PARAGRAPH 1.1.1

ET/DR&C, Prague, 22-26 April 2002

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ANNEX TO PARAGRAPH 2.3

1. E-mail questionnaire on GRIB 2 validation and software:

Question	Decoder	Encoder
Is your centre implementing, or do you intent to implement, a decoder or encoder for GRIB Edition 2?		
If you are implementing a GRIB Edition 2 encoder or decoder, are you developing your own software (so type OWN) or are you implementing software developed elsewhere (if so, please indicate the name of the originating centre)?		
If you are developing your own software, which templates do you intent to support? Please give for each (set of) template(s) the date when you expect to have support for the template available and indicate whether or not you are willing to participate in final validation tests with other centres		
What programming languages are being used for your GRIB Edition 2 software?		
Which operating system and hardware platforms are being used?		
What programming languages will be supported by the Application Program Interface (API) provided by your GRIB Edition 2 software?		
Are you willing to participate in efforts to standardize the API used for encoders and decoders?		

2. Results of questionnaire on GRIB 2 package

2.1 During the last meeting of ET/DR&C, a GRIB 2 questionnaire was designed to help validation and with a view to assist migration. It was distributed by e-mail to representatives of Australia, Canada, DWD, JMA, Météo France, USA, UKMO and ECMWF, and to other potential data producers. Each centre was expected to give the following information about their use of GRIB 2 package(s):

- current status of encoding/decoding
- willingness to participate to final validation tests
- templates intended for use (in the medium term), and estimated target dates associated
- information on programming languages used for package(s) and associated platform(s)/operating system(s)
- information on programming languages supported by application interfaces (APIs)
- willingness to participate to a possible development of a standard API for GRIB 2 software.

2.2 Answers were received in May and June 2001 from Australia, Czech Republic, Météo France (informal); USA (from NWS: NCEP and MDL) and ECMWF.

2.3 All answers (but one) mentioned the intention to implement a package (CHMI for decoding only, BoM reserved for encoding). NCEP, MDL and ECMWF (we might add JMA and UKMO) referred to their own software; BoM mentioned potential use of either ECMWF or NCEP software; Météo France referred use of ECMWF software (with some contribution about complex packing related templates).

2.4 Validated templates:

- All templates but 5.1, 5.51 and associated 7.* (nor most recent ones: 3.1xxx/4.1yyy/4.9/4.10) were reported to be supported at NCEP.
- -MDL reported support of GDT 3.(0/10/20/30/90/110/120) and PDT 4.(0/1/2/8/20/30); PDT 4.9

was expected to be supported in July.

- -ECMWF expected support of GDT 3.(0 to 3, 10/to/30/by/10, 40 to 43, 50 to 53, 90), PDT 4.(0/1/5/7/30), DRT 5.(0/2/3/50/51) and associated DTs.

2.5 NCEP mentioned explicitly its willingness to participate to final validation tests. This was done in cooperation with ECMWF and MDL.

2.6 Programming languages/operating systems mentioned for GRIB 2 package itself were FORTRAN90/UNIX for NCEP, FORTRAN77 and C/LINUX and most UNIX dialect/platform combinations for ECMWF (HP-UX, UXP/V for Fujitsu/VPPs, IRIX for SGI, AIX for IBM RS6000 and SP). BoM was expecting use on HP-UX, from Fortran and possibly C. Météo France was expecting use on HP-UX, LINUX, Sun/Solaris, Fujitsu/VPP from both Fortran and C.

2.7 The last question was inserted at the request of the Chairman of ET/MTDCF. NCEP, ECMWF, BoM and Météo France reported to be willing to participate in efforts to standardize the API for encoders and decoders.

Annex to paragraph 2.4

Product Definition Template 4.11: Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval

Octet No.	Contents
10	Parameter category (see Code Table 4.1)
11	Parameter number (see Code Table 4.2)
12	Type of generating process (see Code Table 4.3)
13	Background generating process identifier (defined by originating Centre)
14	Forecast generating process identifier (defined by originating Centre)
15-16	Hours after reference time of data cut-off (see Note 1)
17	Minutes after reference time of data cut-off
18	Indicator of unit of time range (see Code Table 4.4)
19-22	Forecast time in units defined by octet 18 (see Note 2)
23	Type of first fixed surface (see Code Table 4.5)
24	Scale factor of first fixed surface
25-28	Scaled value of first fixed surface
29	Type of second fixed surface (see Code Table 4.5)
30	Scale factor of second fixed surface
31-34	Scaled value of second fixed surface
35	Type of ensemble forecast (see Code Table 4.6)
36	Perturbation number
37	Number of forecasts in ensemble
38-39	Year of end of overall time interval
40	Month of end of overall time interval
41	Day of end of overall time interval
42	Hour of end of overall time interval
43	Minute of end of overall time interval
44	Second of end of overall time interval
45	n - Number of time range specifications describing the time intervals used to calculate the statistically processed field
46-49	Total number of data values missing in statistical process
50-61	*Specification of the outermost (or only) time range over which statistical processing is done*
50	Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code Table 4.10)
51	Type of time increment between successive fields used in the statistical processing (see Code Table 4.11)
52	Indicator of unit of time for time range over which statistical processing is done (see Code Table 4.4)
53-56	Length of the time range over which statistical processing is done, in units defined by the previous octet
57	Indicator of unit of time for the increment between the successive fields used (see Code Table 4.4)
58-61	Time increment between successive fields, in units defined by the previous octet (see Note 3)
62-nn	*These octets are included only if n>1, where nn = 49 + 12*n*
62-73	As octets 50 to 61, next innermost step of processing
74-nn	Additional time range specifications, included in accordance with the value of n. Contents as octets 50 to 61, repeated as necessary.

Notes:

(1) Hours greater than 65534 will be coded as 65534.
(2) The reference time in section 1 and the forecast time together define the beginning of the overall time interval.
(3) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a rain gauge. The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 51, 63, 75 ...). For all but the innermost (last) time range, the next inner range is then processed using these reference and forecast times as the initial reference and forecast time.

Product Definition Template 4.12: Derived forecasts based on all ensemble members at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval

Octet No.	Contents
10	Parameter category (see Code Table 4.1)
11	Parameter number (see Code Table 4.2)
12	Type of generating process (see Code Table 4.3)
13	Background generating process identifier (defined by originating Centre)
14	Forecast generating process identifier (defined by originating Centre)
15-16	Hours after reference time of data cut-off (see Note 1)
17	Minutes after reference time of data cut-off
18	Indicator of unit of time range (see Code Table 4.4)
19-22	Forecast time in units defined by octet 18 (see Note 2)
23	Type of first fixed surface (see Code Table 4.5)
24	Scale factor of first fixed surface
25-28	Scaled value of first fixed surface
29	Type of second fixed surface (see Code Table 4.5)
30	Scale factor of second fixed surface
31-34	Scaled value of second fixed surface
35	Derived forecast (see Code Table 4.7)
36	Number of forecasts in ensemble
37-38	Year of end of overall time interval
39	Month of end of overall time interval
40	Day of end of overall time interval
41	Hour of end of overall time interval
42	Minute of end of overall time interval
43	Second of end of overall time interval
44	n - Number of time range specifications describing the time intervals used to calculate the statistically processed field
45-48	Total number of data values missing in statistical process.
49-60	*Specification of the outermost (or only) time range over which statistical processing is done*
49	Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code Table 4.10)
50	Type of time increment between successive fields used in the statistical processing (see Code Table 4.11)
51	Indicator of unit of time for time range over which statistical processing is done (see Code Table 4.4)
52-55	Length of the time range over which statistical processing is done, in units defined by the previous octet
56	Indicator of unit of time for the increment between the successive fields used (see Code Table 4.4)
57-60	Time increment between successive fields, in units defined by the previous octet (see Notes 3 and 4)
61-nn	*These octets are included only if n>1, where nn = 48 + 12*n*
61-72	As octets 49 to 60, next innermost step of processing
73-nn	Additional time range specifications, included in accordance with the value of n. Contents as octets 49 to 60, repeated as necessary.

Notes:

(1) Hours greater than 65534 will be coded as 65534.
(2) The reference time in section 1 and the forecast time together define the beginning of the overall time interval.
(3) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a rain gauge.
(4) The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 50, 62, 74 ...). For all but the innermost (last) time range, the next inner range is then processed using these reference and forecast times as the initial reference and forecast time.

Product Definition Template 4.13 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 time interval

Octet No.	Contents
10	Parameter category (see Code Table 4.1)
11	Parameter number (see Code Table 4.2)
12	Type of generating process (see Code Table 4.3)
13	Background generating process identifier (defined by originating Centre)
14	Forecast generating process identifier (defined by originating Centre)
15-16	Hours after reference time of data cut-off (see Note 1)
17	Minutes after reference time of data cut-off
18	Indicator of unit of time range (see Code Table 4.4)
19-22	Forecast time in units defined by octet 18 (see Note 2)
23	Type of first fixed surface (see Code Table 4.5)
24	Scale factor of first fixed surface
25-28	Scaled value of first fixed surface
29	Type of second fixed surface (see Code Table 4.5)
30	Scale factor of second fixed surface
31-34	Scaled value of second fixed surface
35	Derived forecast (see Code Table 4.7)
36	Number of forecasts in the ensemble (N)
37	Cluster identifier
38	Number of cluster to which the high resolution control belongs
39	Number of cluster to which the low resolution control belongs
40	Total number of clusters
41	Clustering method (see Code Table 4.8)
42-45	Northern latitude of cluster domain
46-49	Southern latitude of cluster domain
50-53	Eastern longitude of cluster domain
54-57	Western longitude of cluster domain
58	N_C - Number of forecasts in the cluster
59	Scale factor of standard deviation in the cluster
60-63	Scaled value of standard deviation in the cluster
64	Scale factor of distance of the cluster from ensemble mean
65-68	Scaled value of distance of the cluster from ensemble mean
69-70	Year of end of overall time interval
71	Month of end of overall time interval
72	Day of end of overall time interval
73	Hour of end of overall time interval
74	Minute of end of overall time interval
75	Second of end of overall time interval
76	n - Number of time range specifications describing the time intervals used to calculate the statistically processed field
77-80	Total number of data values missing in statistical process.
81-92	*Specification of the outermost (or only) time range over which statistical processing is done*
81	Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code Table 4.10)
82	Type of time increment between successive fields used in the statistical processing (see Code Table 4.11)
83	Indicator of unit of time for time range over which statistical processing is done (see Code Table 4.4)
84-87	Length of the time range over which statistical processing is done, in units defined by the

previous octet

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

89-92 Time increment between successive fields, in units defined by the previous octet (see Notes 3 and 4)

*93-nn These octets are included only if n>1, where nn = 80+ 12*n*

93-104 As octets 81 to 92, next innermost step of processing

105-nn Additional time range specifications, included in accordance with the value of n. Contents as octets 81 to 92, repeated as necessary.

(nn+1)-(nn+ N_C) List of N_C ensemble forecast numbers (N_C is given in octet 58)

Notes:

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

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

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

(4) The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 82, 94, 106,....). For all but the innermost (last) time range, the next inner range is then processed using these reference and forecast times as the initial reference and forecast time.

In existing PDT 4.3:

Insert and change after octet 57:

58 N_C - Number of forecasts in the cluster

59 Scale factor of standard deviation in the cluster

60-63 Scaled value of standard deviation in the cluster

64 Scale factor of distance of the cluster from ensemble mean

65-68 Scaled value of distance of the cluster from ensemble mean

69-(68+N_C) List of N_C ensemble forecast numbers (N_C is given in octet 58)

Product Definition Template 4.14: 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 time interval

Octet No.	Contents
10	Parameter category (see Code Table 4.1)
11	Parameter number (see Code Table 4.2)
12	Type of generating process (see Code Table 4.3)
13	Background generating process identifier (defined by originating Centre)
14	Forecast generating process identifier (defined by originating Centre)
15-16	Hours after reference time of data cut-off (see Note 1)
17	Minutes after reference time of data cut-off
18	Indicator of unit of time range (see Code Table 4.4)
19-22	Forecast time in units defined by octet 18 (see Note 2)
23	Type of first fixed surface (see Code Table 4.5)
24	Scale factor of first fixed surface
25-28	Scaled value of first fixed surface
29	Type of second fixed surface (see Code Table 4.5)
30	Scale factor of second fixed surface
31-34	Scaled value of second fixed surface
35	Derived forecast (see Code Table 4.7)
36	Number of forecasts in the ensemble (N)
37	Cluster identifier
38	Number of cluster to which the high resolution control belongs
39	Number of cluster to which the low resolution control belongs
40	Total number of clusters
41	Clustering method (see Code Table 4.8)
42-45	Latitude of central point in cluster domain
46-49	Longitude of central point in cluster domain
50-53	Radius of cluster domain
54	N_C - Number of forecasts in the cluster
55	Scale factor of standard deviation in the cluster
56-59	Scaled value of standard deviation in the cluster
60	Scale factor of distance of the cluster from ensemble mean
61-64	Scaled value of distance of the cluster from ensemble mean
65-66	Year of end of overall time interval
67	Month of end of overall time interval
68	Day of end of overall time interval
69	Hour of end of overall time interval
70	Minute of end of overall time interval
71	Second of end of overall time interval
72	n - Number of time range specifications describing the time intervals used to calculate the statistically processed field
73-76	Total number of data values missing in statistical process.
77-88	*Specification of the outermost (or only) time range over which statistical processing is done*
77	Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code Table 4.10)
78	Type of time increment between successive fields used in the statistical processing (see Code Table 4.11)
79	Indicator of unit of time for time range over which statistical processing is done (see Code Table 4.4)
80-83	Length of the time range over which statistical processing is done, in units defined by the previous octet

84 Indicator of unit of time for the increment between the successive fields used (see Code Table 4.4)
85-88 Time increment between successive fields, in units defined by the previous octet (see Notes 3 and 4)

89-nn *These octets are included only if n>1, where nn = 76 + 12*n*

89-110 As octets 77 to 88, next innermost step of processing
111-nn Additional time range specifications, included in accordance with the value of n. Contents as octets 77 to 88, repeated as necessary.
(nn+1)-(nn+N_C) List of N_C ensemble forecast numbers (N_C is given in octet 54)

Notes:

(1) Hours greater than 65534 will be coded as 65534.
(2) The reference time in section 1 and the forecast time together define the beginning of the overall time interval.
(3) An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a rain gauge.
(4) The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 78, 90, 112...). For all but the innermost (last) time range, the next inner range is then processed using these reference and forecast times as the initial reference and forecast time.

In existing PDT 4.4:

Insert and change after octet 53:

54 N_C - Number of forecasts in the cluster
55 Scale factor of standard deviation in the cluster
56-59 Scaled value of standard deviation in the cluster
60 Scale factor of distance of the cluster from ensemble mean
61-64 Scaled value of distance of the cluster from ensemble mean
65-(64+N_C) List of N_C ensemble forecast numbers (N_C is given in octet 54)

Add note to Product Definition Template 4.30:

Note:

For "satellite series of band number", "satellite numbers of band number" and "instrument type of band number", it is recommended to encode the values as per BUFR code tables 0-02-020, 0-01-007 (Common Code Table C-5) and 0-02-019 (Common Code Table C-8) respectively.

***In* Code Table 4.0 (Product Definition Template Number)**

Add:

Code figure	Meaning
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

***In* Code Table 4.2**

Product Discipline 0 : Meteorological products **Parameter Category 18 : Nuclear/radiology**

Code figure	Field parameter	Units
6	Time-integrated air concentration of caesium pollutant	Bq s m^{-3}.
7	Time-integrated air concentration of iodine pollutant	Bq s m^{-3}
8	Time-integrated air concentration of radioactive pollutant	Bq s m^{-3}
9-191	Reserved	

Product Discipline 3 : Space products **Parameter Category 0 : Image products**

Code figure	Field parameter	Units
7	Cloud mask	code table (4.217)
8-191	Reserved	

Add:

Code Table 4.217: Cloud mask type

Code figure	Meaning
0	Clear over water
1	Clear over land
2	Cloud
3	No data
4-191	Reserved
192-254	Reserved for local use
255	Missing

Modify:

Code table 4.7 – Derived forecast

Code figure	
0	Unweighted mean of all members
1	Weighted mean of all members
2	Standard deviation with respect to cluster mean
3	Standard deviation with respect to cluster mean, normalized
4	*Spread of all members*
5	*Large Anomaly Index of all members (see note 1)*
6	*Unweighted mean of the cluster members*
7-191	Reserved
192-254	Reserved for local use
255	Missing

Add Note:

(1) Large Anomaly Index; this index defined as {number of members whose anomaly is higher than 0.5xSD) – (number of members whose anomaly is lower than –0.5xSD)} / {number of members} at each grid point, where SD is defined as observed climatological standard deviation.

ANNEX TO PARAGRAPH 2.5.2

In GRIB section 1 modify the following entries as:

22-23	N – Number included in calculation when octet 21 (Code table 5) refers to a statistical process, such as average or accumulation, otherwise set to zero
24	Number missing from calculation in case of statistical process

In Code table 3 add:

Code figure	Meaning
202-209	Reserved
210	ISOBARIC SURFACE (high precision) Pressure in Pa (2 octets)
211-254	Reserved for local use
255	Missing

In Code table 5 add:

Code figure	Meaning
6	Average (reference time –P1 to reference time –P2)
7	Average (reference time –P1 to reference time +P2)
8-9	Reserved
10	*(unchanged)*
11-50	Reserved
51	Climatological Mean Value: multiple year averages of quantities which are themselves means over some period of time (P2) less than a year. The reference time (R) indicates the date and time of the start of a period of time, given by R to R + P2, over which a mean is formed; N indicates the number of such period-means that are averaged together to form the climatological value, assuming that the N period-mean fields are separated by one year. The reference time indicates the start of the N-year climatology. If P1 = 0 then the data averaged in the basic interval P2 are assumed to be continuous, i.e., all available data are simply averaged together. If P1 = 1 (the unit of time - octet 18, code table 4 - is not relevant here) then the data averaged together in the basic interval P2 are valid only at the time (hour, minute) given in the reference time, for all the days included in the P2 period. The units of P2 are given by the contents of octet 18 and Table 4.
52-112	Reserved
(…)	
125	Standard deviation of N forecasts, all with the same reference time with respect to time average of the time tendency of forecasts; the first forecast has a forecast period of P1, the remaining forecasts follow at intervals of P2.
126-127	Reserved
128-254	Reserved for local use
255	Missing

ANNEX TO PARAGRAPH 3.1

A3.1.1 Agreement has been reached regarding the improvement of terminology for the two basic vertical co-ordinates of a station. In the new "Observing Stations, WMO Publication No. 9, Volume A1" (under preparation), the terms "ground elevation" and "elevation of barometer" are used. Discussion at various meetings has shown that it is highly preferable to use the proposed new descriptor 0 07 031 for representation of "Height of barometer above mean sea level " exclusively.

A3.1.2 Referring to the above given discussion, it is proposed to introduce the following new descriptors:

0 07 030	Height of station ground above mean sea level	m	1	- 4000	17
0 07 031	Height of barometer above mean sea level	m	1	- 4000	17
0 07 032	Height of sensor above local ground	m	2	0	12

with notes added under Table B, Class 7, referring to 0 07 030, 0 07 031 and 0 07 032:

- Height of station ground above mean sea level is defined as the height above mean sea-level of the ground on which the raingauge stands or, if there is no raingauge, the ground beneath the thermometer screen. If there is neither raingauge nor screen, it is the average level of terrain in the vicinity of the station (Reference: Guide to Meteorological Instruments and Methods of Observation, WMO-No. 8. 1996).
- Height of barometer above mean sea level, referring to the location of barometer of a station, does not redefine the descriptor 0 07 030.
- Height of sensor above local ground is the actual height above ground at the point where the sensor is located. This descriptor does not redefine the descriptor 0 07 030.

And a note to be added to the existing descriptor 0 07 001:

- This descriptor should be used for archived data only. Descriptors 0 07 030 and 0 07 031 should be used and preferred to represent ground elevation and elevation of barometer, respectively, as defined in Observing Stations, WMO Publication No. 9, Volume A1.

A3.1.3 Descriptors (needed particularly for the AWS)

0 02 175	Method of precipitation measurement	Code table	0	0	4
0 02 176	Method of state of ground measurement	Code table	0	0	4
0 02 177	Method of snow depth measurement	Code table	0	0	4
0 02 178	Method of liquid content measurement of precipitation	Code table	0	0	4
0 02 179	Type of sky condition algorithm	Code table	0	0	4
0 02 180	Main present weather detecting system	Code table	0	0	4
0 02 181	Supplementary present weather sensor	Flag table	0	0	21
0 02 182	Visibility measurement system	Code table	0	0	4
0 02 183	Cloud detection system	Code table	0	0	4
0 02 184	Type of lightning detection sensor	Code table	0	0	4
0 02 185	Method of evaporation measurement	Code table	0	0	4
0 02 186	Capability to detect precipitation phenomena	Flag table	0	0	30
0 02 187	Capability to detect other weather phenomena	Flag table	0	0	18
0 02 188	Capability to detect obscuration	Flag table	0	0	21
0 02 189	Capability to discriminate lightning strikes	Flag table	0	0	12
0 08 010	Surface qualifier (temperature data)	Code table	0	0	4
0 26 020	Duration of precipitation	Minute	0	0	11
0 33 005	Quality information (AWS data)	Flag table	0	0	30

0 33 006	Internal measurement status information (AWS)	Code table	0	0	3

A3.1.4 Minor addition to the Flag Table 0 20 021

The existing entries of the flag table 0 20 021 are not capable to represent the phenomenon "White dew". Therefore it is proposed to introduce a new entry:

Bit No. 23 White dew

A3.1.5 New sequence descriptors

The following new sequence descriptors are required:

3 01 004, 3 01 090, 3 01 091, 3 02 069, 3 02 070, 3 02 071, 3 02 072, 3 02 073, 3 02 074, 3 02 075, 3 02 076, 3 02 077, 3 02 078, 3 02 079, 3 02 080, 3 02 081, 3 02 082, 3 02 083.

3 01 004		**Surface station identification**
	0 01 001	WMO block number
	0 01 002	WMO station number
	0 01 015	Station or site name
	0 02 001	Type of station

3 01 090		**Surface station identification; time, horizontal and vertical co-ordinates**
3 01 004		Surface station identification
	0 01 001	WMO block number
	0 01 002	WMO station number
	0 01 015	Station or site name
	0 02 001	Type of station
3 01 011	0 04 001	Year
	0 04 002	Month
	0 04 003	Day
3 01 012	0 04 004	Hour
	0 04 005	Minute
3 01 021	0 05 001	Latitude (high accuracy)
	0 06 001	Longitude (high accuracy)
0 07 030		Height of station ground above mean sea level
0 07 031		Height of barometer above mean sea level

3 01 091 **Surface station instrumentation**

0 02 180	Main present weather detecting system
0 02 181	Supplementary present weather sensor
0 02 182	Visibility measurement system
0 02 183	Cloud detection system
0 02 184	Type of lightning detection sensor
0 02 179	Type of sky condition algorithm
0 02 186	Capability to detect precipitation phenomena
0 02 187	Capability to detect other weather phenomena
0 02 188	Capability to detect obscuration
0 02 189	Capability to discriminate lightning strikes

3 02 069 **Visibility data**

0 07 032	Height of sensor above local ground
0 33 041	Attribute of following value
0 20 001	Horizontal visibility

3 02 070 **Wind data**

0 07 032	Height of sensor above local ground
0 11 001	Wind direction
0 11 002	Wind speed
0 11 043	Maximum wind gust direction
0 11 041	Maximum wind gust speed
0 11 016	Extreme counterclockwise wind direction of a variable wind
0 11 017	Extreme clockwise wind direction of a variable wind

3 02 071 **Wind data from one-hour period**

0 07 032	Height of sensor above local ground
0 08 021	Time significance (= 2 (time averaged))
0 04 025	Time period (= - 10 minutes, or number of minutes after a significant change of wind, if any)
0 11 001	Wind direction
0 11 002	Wind speed
0 08 021	Time significance (= missing value)
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)
0 11 043	Maximum wind gust direction
0 11 041	Maximum wind gust speed
0 04 025	Time period (= - 10 minutes)
0 11 016	Extreme counterclockwise wind direction of a variable wind
0 11 017	Extreme clockwise wind direction of a variable wind

3 02 072 **Temperature and humidity data**

0 07 032	Height of sensor above local ground
0 12 101	Temperature/dry-bulb temperature (scale 2)
0 12 103	Dew-point temperature (scale 2)
0 13 003	Relative humidity

3 02 073 **Cloud data**

0 20 010	Cloud cover (total)
1 05 004	Replicate 5 descriptors four times

0 08 002 Vertical significance
0 20 011 Cloud amount
0 20 012 Cloud type
0 33 041 Attribute of following value
0 20 013 Height of base of cloud

3 02 074 Present and past weather

0 20 003 Present weather
0 04 025 Time period
0 20 004 Past weather (1)
0 20 005 Past weather (2)

3 02 075 Intensity of precipitation, size of precipitation element

0 08 021 Time significance (= 2 (time averaged))
0 04 025 Time period (= - 10 minutes)
0 13 055 Intensity of precipitation
0 13 058 Size of precipitation element
0 08 021 Time significance (= missing value)

3 02 076 Precipitation, obscuration and other phenomena

0 20 021 Type of precipitation
0 20 022 Character of precipitation
0 26 020 Duration of precipitation
0 20 023 Other weather phenomena
0 20 024 Intensity of phenomena
0 20 025 Obscuration
0 20 026 Character of obscuration

3 02 077 Extreme temperature data

0 07 032 Height of sensor above local ground
0 04 025 Time period
0 12 111 Maximum temperature (scale 2) at height and over period specified
0 12 112 Minimum temperature (scale 2) at height and over period specified
0 07 032 Height of sensor above local ground (for ground temperature)
0 04 025 Time period
0 12 112 Minimum temperature (scale 2) at height and over period specified (for ground temperature)

3 02 078 State of ground and snow depth measurement

0 02 176 Method of state of ground measurement
0 20 062 State of ground (with or without snow)
0 02 177 Method of snow depth measurement
0 13 013 Total snow depth

3 02 079 Precipitation measurement

0 07 032 Height of sensor above local ground
0 02 175 Method of precipitation measurement
0 02 178 Method of liquid water content measurement of precipitation
0 04 025 Time period
0 13 011 Total precipitation / total water equivalent of snow

3 02 080		**Evaporation measurement**
	0 02 185	**Method of evaporation measurement**
	0 04 025	Time period
	0 13 033	Evaporation /evapotranspiration
3 02 081		**Total sunshine data**
	0 04 025	Time period
	0 14 031	Total sunshine
3 02 082		**Radiation data**
	0 04 025	Time period
	0 14 002	Long-wave radiation, integrated over period specified
	0 14 004	Short-wave radiation, integrated over period specified
	0 14 016	Net radiation, integrated over period specified
	0 14 028	Global solar radiation (high accuracy), integrated over period specified
	0 14 029	Diffuse solar radiation (high accuracy), integrated over period specified
	0 14 030	Direct solar radiation (high accuracy), integrated over period specified
3 02 083		**First order statistics of P, W, T, U data**
	0 04 025	Time period
	0 08 023	First order statistics
	0 10 004	Pressure
	0 11 001	Wind direction
	0 11 002	Wind speed
	0 12 101	Temperature/dry-bulb temperature (scale 2)
	0 13 003	Relative humidity
	0 08 023	First order statistics (= missing value)

A3.1.6 New Code Tables or Flag Tables

0 02 175
Method of precipitation measurement

Code figure	
0	Manual measurement
1	Tipping bucket method
2	Weighing method
3	Optical method
4	Pressure method
5	Float method
6	Drop counter method
7-13	Reserved
14	Others
15	Missing value

0 02 176
Method of state of ground measurement

Code figure	
0	Manual observation
1	Video camera method
2	Infra-red method
3	Laser method
4-13	Reserved
14	Others
15	Missing value

0 02 177
Method of snow depth measurement

Code figure	
0	Manual observation
1	Ultrasonic method
2	Video camera method
3-13	Reserved
14	Others
15	Missing value

0 02 178
Method of liquid content measurement of precipitation

Code figure	
0	Manual observation
1	Optical method
2	Capacitive method
3-13	Reserved
14	Others
15	Missing value

0 02 179

Type of sky condition algorithm

Code figure	
0	Manual observation
1	VAISALA algorithm
2	ASOS (FAA) algorithm
3	AWOS (Canada) algorithm
4-13	Reserved
14	Others
15	Missing value

0 02 180

Main present weather detecting system

Code Figure	
0	Manual observation
1	Optical scatter system combined with precipitation occurrence sensing system
2	Forward and/or back-scatter system of visible light
3	Forward and/or back-scatter system of infrared light
4	Infrared light emitting diode (IRED) system
5	Doppler radar system
6-13	Reserved
14	Others
15	Missing value

0 02 181

Supplementary present weather sensor

Bit No.	
1	Rain detector
2	Freezing rain sensor
3	Ice detection sensor
4	Hail and ice pellet sensor
5-19	Reserved
20	Others
All 21	Missing value

0 02 182

Visibility measurement system

Code figure	
0	Manual measurement
1	Transmissometer system (base 25 m)
2	Transmissometer system (base < 25 m)
3	Forward scatter system
4	Back scatter system
5-13	Reserved
14	Others
15	Missing value

0 02 183

Cloud detection system

Code figure	
0	Manual observation
1	Ceilometer system
2	Infrared camera system
3	Microwave visual camera system
4	Sky imager system
5	Video time lapsed camera system
6	Micro pulse lidar (MPL) system
7-13	Reserved
14	Others
15	Missing value

0 02 184

Type of lightning detection sensor

Code figure	
0	Manual observation
1	Lightning imaging sensor
2	Electrical storm identification sensor
3	Magnetic finder sensor
4	Lightning strike sensor
5	Flash counter
6-13	Reserved
14	Others
15	Missing value

0 02 185

Method of evaporation measurement

Code Figure	
0	Manual measurement
1	Balanced floating method
2	Pressure method
3	Ultrasonic method
4	Hydraulic method
5-13	Reserved
14	Others
15	Missing value

0 02 186

Capability to detect precipitation phenomena

Bit No.	
1	Precipitation-unknown type
2	Liquid precipitation not freezing
3	Liquid freezing precipitation
4	Drizzle
5	Rain
6	Solid precipitation
7	Snow
8	Snow grains
9	Snow pellets
10	Ice pellets
11	Ice crystals
12	Diamond dust
13	Small hail
14	Hail
15	Glaze
16	Rime
17	Soft rime
18	Hard rime
19	Clear ice
20	Wet snow
21	Hoar frost
22	Dew
23	White dew
24-29	Reserved
All 30	Missing value

0 02 187

Capability to detect other weather phenomena

Bit No.	
1	Dust/sand whirl
2	Squalls
3	Sand storm
4	Dust storm
5	Lightning - cloud to surface
6	Lightning - cloud to cloud
7	Lightning - distant
8	Thunderstorm
9	Funnel Cloud not touching surface
10	Funnel cloud touching surface
11	Spray
12-17	Reserved
All 18	Missing value

0 02 188

Capability to detect obscuration

Bit No.	
1	Fog
2	Ice fog
3	Steam fog
4-6	Reserved
7	Mist
8	Haze
9	Smoke
10	Volcanic ash
11	Dust
12	Sand
13	Snow
14-20	Reserved
All 21	Missing value

0 02 189

Capability to discriminate lightning strikes

Bit No.	
1	Manual observation
2	All lightning strikes without discrimination
3	Lightning strikes cloud to ground only
4	All lightning strikes with discrimination between cloud to ground and cloud to cloud
5-11	Reserved
All 12	Missing value

0 08 010

Surface qualifier (for temperature data)

Code figure	
0	Reserved
1	Bare soil
2	Bare rock
3	Land grass cover
4	Water (lake, sea)
5	Flood water underneath
6	Snow
7	Ice
8	Runway or road
9-14	Reserved
15	Missing value

0 33 005

Quality Information (AWS data)

Bit No.	
1	No automated meteorological data checks performed
2	Pressure data suspect
3	Wind data suspect
4	Dry-bulb temperature data suspect
5	Wet-bulb temperature data suspect
6	Humidity data suspect
7	Ground temperature data suspect
8	Soil temperature (depth 1) data suspect
9	Soil temperature (depth 2) data suspect
10	Soil temperature (depth 3) data suspect
11	Soil temperature (depth 4) data suspect
12	Soil temperature (depth 5) data suspect
13	Cloud data suspect
14	Visibility data suspect
15	Present weather data suspect
16	Lightning data suspect
17	Ice deposit data suspect
18	Precipitation data suspect
19	State of ground data suspect
20	Snow data suspect
21	Water content data suspect
22	Evaporation/evapotranspiration data suspect
23	Sunshine data suspect
24-29	Reserved
All 30	Missing value

0 33 006

Internal measurement status information (AWS)

Code figure	
0	Self-check OK
1	At least one Warning active, no Alarms
2	At least one Alarm active
3	Sensor failure
4-6	Reserved
7	Missing value

A3.1.7 A BUFR template for AWS data from n-minute period

3 01 090		**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
3 01 091		**Surface station instrumentation**	
	0 02 180	Main present weather detecting system	Code table
	0 02 181	Supplementary present weather sensor	Flag table
	0 02 182	Visibility measurement system	Code table
	0 02 183	Cloud detection system	Code table
	0 02 184	Type of lightning detection sensor	Code table
	0 02 179	Type of sky condition algorithm	Code table
	0 02 186	Capability to detect precipitation phenomena	Flag table
	0 02 187	Capability to detect other weather phenomena	Flag table
	0 02 188	Capability to detect obscuration	Flag table
	0 02 189	Capability to discriminate lightning strikes	Flag table
0 04 025		Time displacement (= - n minutes)	Minute
0 04 065		Short time increment (= 1 minute)	Minute
1 13 n		**Replicate 13 descriptors n- times**	
		E.g.: 1 13 006 in case of 6-minute period, *1 13 010 in case of 10-minute period*	
0 10 004		Pressure	Pa, scale –1
3 02 070		**Wind data**	
	0 07 032	Height of sensor above local ground	m, scale 2
	0 11 001	Wind direction	Degree true
	0 11 002	Wind speed	m s^{-1}
	0 11 043	Maximum wind gust direction	Degree true
	0 11 041	Maximum wind gust speed	m s^{-1}
	0 11 016	Extreme counterclockwise wind direction of a variable wind	Degree true
	0 11 017	Extreme clockwise wind direction of a variable wind	Degree true
3 02 072		**Temperature and humidity data**	
	0 07 032	Height of sensor above local ground	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	m, scale 2
0 12 101		Temperature/dry-bulb temperature (scale 2) (for ground temperature)	K, scale 2

1 01 005		Replicate one descriptors 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 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
3 02 073		**Cloud data**	
	0 20 010	Cloud cover (total)	%
	1 05 004	Replicate 5 descriptors four times	
	0 08 002	Vertical significance	Code table
	0 20 011	Cloud amount	Code table
	0 20 012	Cloud type	Code table
	0 33 041	Attribute of following value	Code table
	0 20 013	Height of base of cloud	m, scale –1
3 02 076		**Precipitation, obscuration and other phenomena**	
	0 20 021	Type of precipitation	Flag table
	0 20 022	Character of precipitation	Code table
	0 26 020	Duration of precipitation	Minute
	0 20 023	Other weather phenomena	Flag table
	0 20 024	Intensity of phenomena	Code table
	0 20 025	Obscuration	Flag table
	0 20 026	Character of obscuration	Code table
0 13 055		Intensity of precipitation	$kgm^{-2}s^{-1}$,scale 4
0 13 058		Size of precipitation element	m, scale 4
		(end of the replicated sequence)	
0 20 031		Ice deposit (thickness)	m, scale 2
0 20 032		Rate of ice accretion	Code table
3 02 078		**State of ground and snow depth measurement**	
	0 02 176	Method of state of ground measurement	Code table
	0 20 062	State of ground (with or without snow)	Code table
	0 02 177	Method of snow depth measurement	Code table
	0 13 013	Total snow depth	m, scale 2
3 02 079		**Precipitation measurement**	
	0 07 032	Height of sensor above local ground	m, scale 2
	0 02 175	Method of precipitation measurement	Code table
	0 02 178	Method of liquid water content measurement of precipitation	Code table
	0 04 025	Time period (= - n minutes)	Minute
	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
3 02 080		**Evaporation measurement**	
	0 02 185	Method of evaporation measurement	Code table
	0 04 025	Time period or displacement (= - n minutes)	Minute
	0 13 033	Evaporation /evapotranspiration	kg m^{-2}
3 02 081		**Total sunshine data**	
	0 04 025	Time period (= - n minutes)	Minute
	0 14 031	Total sunshine	Minute

3 02 082		**Radiation data**	
	0 04 025	Time period (= - n minutes)	Minute
	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 -4
	0 14 029	Diffuse solar radiation (high accuracy), integrated over period specified	J m^{-2}, scale -4
	0 14 030	Direct solar radiation (high accuracy), integrated over period specified	J m^{-2}, scale -4
0 04 025		Time period (= - n minutes)	Minute
0 13 059		Number of flashes	Numeric
3 02 083		**First order statistics of P, W, T, U data**	
	0 04 025	Time period (= - n minutes)	Minute
	0 08 023	First order statistics (= 9; best estimate of standard deviation)	Code table
	0 10 004	Pressure	Pa, scale –1
	0 11 001	Wind direction	Degree true
	0 11 002	Wind speed	m s^{-1}
	0 12 101	Temperature/dry-bulb temperature (scale 2)	K, scale 2
	0 13 003	Relative humidity	%
	0 08 023	First order statistics (= missing value)	Code table
0 33 005		Quality information (AWS data)	Flag table
0 33 006		Internal measurement status information (AWS)	Code table

Notes:

1) The time identification refers to the end of the n-minute period.

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

3) Best estimate of standard deviation 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.

A3.1.8 BUFR template for surface observations from one-hour period

This template is proposed to be used for representation of surface observation data from both automatic stations and manned stations.

3 01 090		**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
3 01 091		**Surface station instrumentation**	
	0 02 180	Main present weather detecting system	Code table
	0 02 181	Supplementary present weather sensor	Flag table
	0 02 182	Visibility measurement system	Code table
	0 02 183	Cloud detection system	Code table
	0 02 184	Type of lightning detection sensor	Code table
	0 02 179	Type of sky condition algorithm	Code table
	0 02 186	Capability to detect precipitation phenomena	Flag table
	0 02 187	Capability to detect other weather phenomena	Flag table
	0 02 188	Capability to detect obscuration	Flag table
	0 02 189	Capability to discriminate lightning strikes	Flag table
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(2)	Pa, scale –1
	0 10 063	Characteristic of pressure tendency(2)	Code table
0 07 004		Pressure (standard level)	Pa, scale –1
0 10 009		Geopotential height of the standard level	gpm
3 02 072		**Temperature and humidity data**	
	0 07 032	Height of sensor above local ground	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	%
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 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 20 031		Ice deposit (thickness)	m, scale 2
0 20 032		Rate of ice accretion	Code table
0 02 038		Method of sea surface temperature measurement	Code table
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
	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 20 062	State of ground (with or without snow)	Code table
	0 02 177	Method of snow depth measurement	Code table
	0 13 013	Total snow depth	m, scale 2
3 02 073		**Cloud data**	
	0 20 010	Cloud cover (total)	%
	1 05 004	Replicate 5 descriptors four times	
	0 08 002	Vertical significance	Code table
	0 20 011	Cloud amount	Code table
	0 20 012	Cloud type	Code table
	0 33 041	Attribute of following value	Code table
	0 20 013	Height of base of cloud	m, scale -1
3 02 074		**Present and past weather**	
	0 20 003	Present weather[3]	Code table
	0 04 025	Time period (= - 60 minutes)	Minute
	0 20 004	Past weather (1) [3]	Code table
	0 20 005	Past weather (2) [3]	Code table
3 02 075		**Intensity of precipitation, size of precip. element**	
	0 08 021	Time significance (= 2 (time averaged))	Code table
	0 04 025	Time period (= - 10 minutes)	Minute
	0 13 055	Intensity of precipitation	$kgm^{-2}s^{-1}$,scale 4
	0 13 058	Size of precipitation element	m, scale 4
	0 08 021	Time significance (= missing value)	Code table
0 04 025		Time period (= - 10 minutes)	Minute
3 02 076		**Precipitation, obscuration and other phenomena**	
	0 20 021	Type of precipitation	Flag table
	0 20 022	Character of precipitation	Code table
	0 26 020	Duration of precipitation [4]	Minute
	0 20 023	Other weather phenomena	Flag table
	0 20 024	Intensity of phenomena	Code table
	0 20 025	Obscuration	Flag table
	0 20 026	Character of obscuration	Code table

3 02 071		**Wind data from one-hour period**	
	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, or number of minutes after a significant change of wind, if any)	Minute
	0 11 001	Wind direction	Degree true
	0 11 002	Wind speed	m s^{-1}
	0 08 021	Time significance (= missing value)	Code table
	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 11 043	Maximum wind gust direction	Degree true
	0 11 041	Maximum wind gust speed	m s^{-1}
	0 04 025	Time period (= - 10 minutes)	Minute
	0 11 016	Extreme counterclockwise wind direction of a variable wind	Degree true
	0 11 017	Extreme clockwise wind direction of a variable wind	Degree true
3 02 077		**Extreme temperature data**	
	0 07 032	Height of sensor above local ground	m, scale 2
	0 04 025	Time period (= - 60 minutes)	Minute
	0 12 111	Maximum temperature (scale 2) at height and over period specified	K, scale 2
	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 12 112	Minimum temperature (scale 2) at height and over period specified (for ground temperature)	K, scale 2
3 02 079		**Precipitation measurement**	
	0 07 032	Height of sensor above local ground	m, scale 2
	0 02 175	Method of precipitation measurement	Code table
	0 02 178	Method of liquid water content measurement of precipitation	Code table
	0 04 025	Time period (= - 60 minutes)	Minute
	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
3 02 080		**Evaporation measurement**	
	0 02 185	Method of evaporation measurement	Code table
	0 04 025	Time period (= - 60 minutes)	Minute
	0 13 033	Evaporation /evapotranspiration	kg m^{-2}
3 02 081		**Total sunshine data**	
	0 04 025	Time period (= - 60 minutes)	Minute
	0 14 031	Total sunshine	Minute
3 02 082		**Radiation data**	
	0 04 025	Time period (= - 60 minutes)	Minute
	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 -4
	0 14 029	Diffuse solar radiation (high accuracy), integrated over period specified	J m^{-2}, scale -4
	0 14 030	Direct solar radiation (high accuracy), integrated over period specified	J m^{-2}, scale -4
0 04 025		Time period (= - 10 minutes)	Minute
0 13 059		Number of flashes	Numeric
3 02 083		**First order statistics of P, W, T, U data**	
	0 04 025	Time period (= -10 minutes)	Minute
	0 08 023	First order statistics (= 9 (best estimate of standard deviation)) (5)	Code table
	0 10 004	Pressure	Pa, scale –1
	0 11 001	Wind direction	Degree true
	0 11 002	Wind speed	m s^{-1}
	0 12 101	Temperature/dry-bulb temperature (scale 2)	K, scale 2
	0 13 003	Relative humidity	%
	0 08 023	First order statistics (= missing value)	Code table
0 33 005		Quality information (AWS data)	Flag table
0 33 006		Internal measurement status information (AWS)	Code table

Notes: (1) The time identification refers to the end of the one-hour period.

(2) 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.

(3) 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.

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

(5) 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.

ANNEX TO PARAGRAPH 3.2.1

A3.2.1.1 BUFR template for SYNOP and SYNOP MOBIL data

		Surface station identification, time, horizontal and vertical coordinates	
3 01 001	0 01 001	WMO block number	Numeric
	0 01 002	WMO station number	Numeric
0 01 011		Mobile land station identifier	CCITT IA5
0 01 003		WMO region number	Code table
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
		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 07 004		Pressure (standard level)	Pa, scale –1
0 10 009		Geopotential height of the standard level	gpm
		Temperature and humidity data	
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	%
		Visibility data	
0 07 032		Height of sensor above local ground (for visibility measurement)	m, scale 2
0 20 001		Horizontal visibility	m, scale –1
		Precipitation past 24 hours	
0 07 032		Height of sensor above local ground (for precipitation measurement)	m, scale 2
0 13 023		Total precipitation past 24 hours	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
		Cloud data	
3 02 004	0 20 010	Cloud cover (total)	%
	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
1 01 004		Replicate next 1 descriptor 4 times	
3 02 005	0 08 002	Vertical significance	Code table

	0 20 011	Cloud amount (N_s)	Code table
	0 20 012	Cloud type (C)	Code table
	0 20 013	Height of base of cloud (h_sh_s)	m, scale -1
		Clouds with bases below station level	
1 05 003		Replicate next 5 descriptors 3 times	
0 08 002		Vertical significance	Code table
0 20 011		Cloud amount	Code table
0 20 012		Cloud type	Code table
0 20 014		Height of top of cloud	m, scale -1
0 20 017		Cloud top description	Code table
		State of ground, snow depth, ground minimum temperature	
0 20 062		State of ground (with or without snow)	Code table
0 13 013		Total snow depth	m, scale 2
0 12 113		Ground minimum temperature (scale2), past 12 hours	K, scale 2
		Present and past weather	
0 20 003		Present weather	Code table
0 04 024		Time period in hours	Hour
0 20 004		Past weather (1)	Code table
0 20 005		Past weather (2)	Code table
		Evaporation measurement	
0 04 024		Time period in hours	Hour
0 02 004		Type of instrument for evaporation or crop type for evapotranspiration	Code table
0 13 033		Evaporation /evapotranspiration	kg m^{-2}
		Sunshine data	
0 04 024		Time period in hours	Hour
0 14 031		Total sunshine	Minute
		Radiation data	
0 04 025		Time period in minutes	Minute
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 -4
0 14 029		Diffuse solar radiation (high accuracy), integrated over period specified	J m^{-2}, scale -4
0 14 030		Direct solar radiation (high accuracy), integrated over period specified	J m^{-2}, scale -4
		Precipitation measurement	
0 07 032		Height of sensor above local ground (for precipitation measurement)	m, scale 2
1 02 002		Replicate next 2 descriptors 2 times	
0 04 024		Time period in hours	Hour
0 13 011		Total precipitation / total water equivalent of snow	kg m^{-2}, scale 1
		Extreme temperature data	
0 07 032		Height of sensor above local ground (for temperature measurement)	m, scale 2
1 01 002		Replicate 1 descriptor 2 times (see Note 1 below)	
0 04 024		Time period in hours	Hour
0 12 111		Maximum temperature (scale 2) at height and over period specified	K, scale 2
0 04 024		Time period in hours	Hour

0 12 112		Minimum temperature (scale 2) at height and over period specified	K, scale 2
		Wind data	
0 07 032		Height of sensor above local ground (for wind measurement)	m, scale 2
0 02 002		Type for instrumentation for wind measurement	Flag table
0 08 021		Time significance (= 2 (time averaged))	Code table
0 04 025		Time period (= - 10 minutes, or number of minutes after a significant change of wind, if any)	Minute
0 11 001		Wind direction	Degree true
0 11 002		Wind speed	m s^{-1}
0 08 021		Time significance (= missing value)	Code table
1 03 002		Replicate next 3 descriptors 2 times	
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}

Notes:

4) 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 replicated two times. If the period ends at the nominal time of the report, value of the second 004024 shall be set to 0.

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

A3.2.1.2 A BUFR template for SHIP data

		Identification, movement, type, date/time, position (coarse accuracy) and vertical coordinates	
3 01 036	0 01 011	Ship or mobile land station identifier	CCITT IA5
	0 01 012	Direction of motion of moving observing platform	Degree true
	0 01 013	Speed of motion of moving observing platform	m s^{-1}
	0 02 001	Type of station	Code table
	0 04 001	Year	Year
	0 04 002	Month	Month
	0 04 003	Day	Day
	0 04 004	Hour	Hour
	0 04 005	Minute	Minute
	0 05 002	Latitude (coarse accuracy)	Degree, scale 2
	0 06 002	Longitude (coarse accuracy)	Degree, scale 2
0 07 030		Height of station platform above mean sea level	m, scale 1
0 07 031		Height of barometer above mean sea level	m, scale 1
		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
		Temperature and humidity data	
0 07 032		Height of sensor above station platform (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	%
		Visibility data	
0 07 032		Height of sensor above station platform (for visibility measurement)	m, scale 2
0 20 001		Horizontal visibility	m, scale –1
		Precipitation past 24 hours	
0 07 032		Height of sensor above station platform (for precipitation measurement)	m, scale 2
0 13 023		Total precipitation past 24 hours	kg m^{-2}, scale 1
0 07 032		Height of sensor above station platform (set to missing to cancel the previous value)	m, scale 2
		Cloud data	
3 02 004	0 20 010	Cloud cover (total)	%
	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
1 01 004		Replicate next 1 descriptor 4 times	
3 02 005	0 08 002	Vertical significance	Code table
	0 20 011	Cloud amount (N_s)	Code table
	0 20 012	Cloud type (C)	Code table
	0 20 013	Height of base of cloud ($h_s h_s$)	m, scale -1
		Ice	
0 20 031		Ice deposit (thickness)	m, scale 2

0 20 032		Rate of ice accretion	Code table
0 20 033		Cause of ice accretion	Flag table
0 20 034		Sea ice concentration	Code table
0 20 035		Amount and type of ice	Code table
0 20 036		Ice situation	Code table
0 20 037		Ice development	Code table
0 20 038		Bearing of ice edge	Degree true
		Sea/water temperature	
0 02 038		Method of sea surface temperature measurement	Code table
0 22 043		Sea/water temperature	K, scale 2
		Waves	
3 02 021	0 22 001	Direction of waves	Degree true
	0 22 011	Period of waves	s
	0 22 021	Height of waves	m, scale 1
3 02 024	0 22 002	Direction of wind waves	Degree true
	0 22 012	Period of wind waves	s
	0 22 022	Height of wind waves	m, scale 1
	1 01 002	Replicate 1 descriptor 2 times	
	3 02 023	Swell waves (2 systems of swell)	
		Present and past weather	
0 20 003		Present weather	Code table
0 04 024		Time period in hours	Hour
0 20 004		Past weather (1)	Code table
0 20 005		Past weather (2)	Code table
		Precipitation measurement	
0 07 032		Height of sensor above station platform (for precipitation measurement)	m, scale 2
1 02 002		Replicate next 2 descriptors 2 times	
0 04 024		Time period in hours	Hour
0 13 011		Total precipitation / total water equivalent of snow	kg m^{-2}, scale 1
		Extreme temperature data	
0 07 032		Height of sensor above station platform (for temperature measurement)	m, scale 2
1 01 002		Replicate 1 descriptor 2 times (see Note 1 below)	
0 04 024		Time period in hours	Hour
0 12 111		Maximum temperature (scale 2) at height and over period specified	K, scale 2
0 04 024		Time period in hours	Hour
0 12 112		Minimum temperature (scale 2) at height and over period specified	K, scale 2
		Wind data	
0 07 032		Height of sensor above station platform (for wind measurement)	m, scale 2
0 02 002		Type for instrumentation for wind measurement	Flag table
0 08 021		Time significance (= 2 (time averaged))	Code table
0 04 025		Time period (= - 10 minutes, or number of minutes after a significant change of wind, if any)	Minute
0 11 001		Wind direction	Degree true
0 11 002		Wind speed	m s^{-1}
0 08 021		Time significance (= missing value)	Code table
1 03 002		Replicate next 3 descriptors 2 times	
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}

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 replicated two times. If the period ends at the nominal time of the report, value of the second 004024 shall be set to 0.

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

A3.2.1.3 BUFR templates for PILOT, PILOT SHIP, PILOT MOBIL

a) with pressure as the vertical coordinate

		Identification and instrumentation	
3 01 001	0 01 001	WMO block number	Numeric
	0 01 002	WMO station number	Numeric
0 01 011		Ship or mobile land station identifier	CCITT IA5
0 02 011		Radiosonde type	Code table
0 02 014		Tracking technique/status of system used	Code table
0 02 003		Type of measuring equipment used	Code table
		Date/time, horizontal and vertical coordinates	
3 01 011	0 04 001	Year	Year
	0 04 002	Month	Month
	0 04 003	Day	Day
0 04 004		Hour	Hour
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 (platform for SHIP) 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
		Level data	
1 04 000		Delayed replication of 4 descriptors	
0 31 001		Delayed descriptor replication factor	Numeric
		Data from a single level	
0 07 004		Pressure	Pa, scale –1
0 08 001		Vertical sounding significance	Flag table
0 11 001		Wind direction	Degree true
0 11 002		Wind speed	m s^{-1}
		Wind shear data	
0 07 004		Pressure	Pa, scale –1
0 08 001		Vertical sounding significance	Flag table
0 11 061		Absolute wind shear in 1 km layer above	m s^{-1}, scale 1
0 11 062		Absolute wind shear in 1 km layer below	m s^{-1}, scale 1

Notes: (1) The following note should be added to the flag table 008001:
"Note that all bits set to zero implies a level of undetermined significance."

b) with height as the vertical coordinate

		Identification and instrumentation	
3 01 001	0 01 001	WMO block number	Numeric
	0 01 002	WMO station number	Numeric
0 01 011		Ship or mobile land station identifier	CCITT IA5
0 02 011		Radiosonde type	Code table
0 02 014		Tracking technique/status of system used	Code table
0 02 003		Type of measuring equipment used	Code table
		Date/time, horizontal and vertical coordinates	
3 01 011	0 04 001	Year	Year
	0 04 002	Month	Month

	0 04 003	Day	Day
0 04 004		Hour	Hour
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 (platform for SHIP) 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
		Level data	
1 04 000		Delayed replication of 4 descriptors	
0 31 001		Delayed descriptor replication factor	Numeric
		Data from a single level	
0 07 009		Geopotential height	gpm
0 08 001		Vertical sounding significance	Flag table
0 11 001		Wind direction	Degree true
0 11 002		Wind speed	m s^{-1}
		Wind shear data	
0 07 009		Geopotential height	gpm
0 08 001		Vertical sounding significance	Flag table
0 11 061		Absolute wind shear in 1 km layer above	m s^{-1}, scale 1
0 11 062		Absolute wind shear in 1 km layer below	m s^{-1}, scale 1

Notes: (1) The following note should be added to the flag table 008001:
"Note that all bits set to zero implies a level of undetermined significance."

A3.2.1.4 BUFR templates for TEMP, TEMP DROP, TEMP SHIP, TEMP MOBIL

		Identification and instrumentation	
3 01 001	0 01 001	WMO block number	Numeric
	0 01 002	WMO station number	Numeric
0 01 011		Ship or mobile land station identifier	CCITT IA5
0 01 006		Aircraft identifier (for dropsondes)	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
		Date/time, date/time of launch, horizontal and vertical coordinates	
3 01 011	0 04 001	Year	Year
	0 04 002	Month	Month
	0 04 003	Day	Day
0 04 004		Hour	Hour
0 08 021		Time significance (value = 18 (radiosonde launch time))	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
0 08 021		Time significance (set to missing to cancel the previous value)	Code table
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 (platform for SHIP) 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
		Sea/water temperature	
0 22 043		Sea/water temperature (for ship stations)	K, scale 2
		Cloud data	
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
		Level data	
1 07 000		Delayed replication of 7 descriptors	
0 31 001		Delayed descriptor replication factor	Numeric
		Data from a single level	
0 07 004		Pressure	Pa, scale –1
0 08 001		Vertical sounding significance	Flag table
0 10 009		Geopotential height	gpm
0 12 101		Temperature/dry-bulb temperature (scale 2)	K, scale 2
0 12 103		Dew-point temperature (scale 2)	K, scale 2
0 11 001		Wind direction	Degree true
0 11 002		Wind speed	$m\ s^{-1}$

		Wind shear data	
0 07 004		Pressure	Pa, scale –1
0 08 001		Vertical sounding significance	Flag table
0 11 061		Absolute wind shear in 1 km layer above	$m\ s^{-1}$, scale 1
0 11 062		Absolute wind shear in 1 km layer below	$m\ s^{-1}$, scale 1

Notes: (1) The following note should be added to the flag table 008001:
"Note that all bits set to zero implies a level of undetermined significance."

A3.2.1.5 Proposed new allocated entries (awaiting validation) for next two templates

0 08 080	Qualifier for GTSPP quality flag	Code Table		0	0	6
B 08 080				0		2
0 33 050	Global GTSPP quality flag	Code Table	0	0	4	
B 33 050				0		2

0 08 080

Qualifier for GTSPP quality flag

Code figure	
0	Total water pressure profile
1	Total water temperature profile
2	Total water salinity profile
3	Total water conductivity profile
4-62	Reserved
63	Missing

0 33 050

Global GTSPP quality flag

Code figure	
0	Unqualified
1	Correct value (all checks passed)
2	Probably good but value inconsistent with statistics (differ from climatology)
3	Probably bad (spike, gradient, … if other tests passed)
4	Bad value, Impossible value (out of scale, vertical instability, constant profile)
5	Value modified during quality control
6-7	Reserved
8	Interpolated value
9-14	Reserved
15	Missing

A3.2.1.6 BUFR Template for XBT/XCTD

001003 - WMO region
001020 - WMO region sub-area
001005 - Buoy/platform identifier
001011 - Ship call sign
001019 - Ship name
001080 - Ship line number according to SOOP
005036 - Ship transect number according to SOOP
001036 - Agency in charge of operating the observing platform
301011 - Date
301012 - Time
301021 - Latitude and longitude (high accuracy)
007030 - Height of station platform above MSL
002040 - Method of removing platform direction and speed from current
022067 - Instrument type for water temperature profile measurement
022068 - Water temperature profile recorder type

008080 - Qualifier for quality flag (total water pressure profile)
033050 - Global GTSPP quality flag (for total water pressure profile as qualified above)
008080 - Qualifier for quality flag (total water temperature profile)
033050 - Global GTSPP quality flag (for total water temperature profile as qualified above)
008080 - Qualifier for quality flag (total water salinity profile)
033050 - Global GTSPP quality flag (for total water salinity profile as qualified above)
008080 - Qualifier for quality flag (total water conductivity profile)
033050 - Global GTSPP quality flag (for total water conductivity profile as qualified above)
025100 - XBT/XCTD fall rate equation coefficient a
025101 - XBT/XCTD fall rate equation coefficient b
022063 - Total depth of water
302021 - Waves
306004 - Sea temperature and salinity profile
002030 - Method of current measurement
306005 - Time/duration of current measurement, depths/directions/speeds
007032 - Height of thermometer above station platform
012101 - Dry-bulb temperature (scale 2)
012103 - Dew-point temperature (scale 2)
007032 - Height of anemometer above station platform
011001 - Wind direction
011002 - Wind speed

Note: A supplementary descriptor for a unique observation identifier may be added later after definition in coordination with DBCP/SOOP.

A3.2.1.7 BUFR Template for subsurface profiling floats

001003 - WMO region
001020 - WMO region sub-area
001005 - Buoy/platform identifier
001085 - Observing platform manufacturers model
001086 - Observing platform manufacturers serial number
002036 - Buoy type
002149 - Type of data buoy
301011 - Date
301012 - Time
301021 - Latitude and longitude (high accuracy)
007030 - Height of station above MSL
002040 - Method of removing platform direction and speed from current
022067 - Instrument type for water temperature profile measurement
022068 - Water temperature profile recorder type
102004 - Replication 4 times of next 2 descriptors
008080 - Qualifier for quality flag (total water pressure profile)
033050 - Global GTSPP quality flag (for total water pressure profile as qualified above)
008080 - Qualifier for quality flag (total water temperature profile)
033050 - Global GTSPP quality flag (for total water temperature profile as qualified above)
008080 - Qualifier for quality flag (total water salinity profile)
033050 - Global GTSPP quality flag (for total water salinity profile as qualified above)
008080 - Qualifier for quality flag (total water conductivity profile)
033050 - Global GTSPP quality flag (for total water conductivity profile as qualified above)
022055 - Float cycle number
022056 - Direction of profile
022063 - Total depth of water
302021 - Waves

002032 - Indicator for digitization
002033 - Method of salinity/depth measurement
103000 - Delayed replication of 3 descriptors
031001 - Delayed descriptor replication factor
007062 - Depth below sea surface
022045 - Subsurface sea temperature (scale 3)
022064 - Salinity (scale 3)
002030 - Method of current measurement
306005 - Time/duration of current measurement, depths/directions/speeds

Note: A supplementary descriptor for a unique observation identifier may be added later after definition in coordination with DBCP/SOOP.

A3.2.1.8 BUFR Template for BUOY

001003 - WMO region
001020 - WMO region sub-area
001005 - Buoy/platform identifier
002001 - Type of station
002036 - Buoy type
002149 - Type of data buoy
301011 - Date
301012 - Time
008021 - Time significance (value = “26" (time of last known position))
301011 - Date
301012 - Time
008021 - Time significance (value = "missing")
301021 - Latitude and longitude (high accuracy)
027004 - Alternate latitude (high accuracy)
028004 - Alternate longitude (high accuracy)
007030 - Height of platform above MSL
001051 - Platform Transmitter ID (CCITT IA5)
002148 - Data collection and/or Location system
001012 - Platform drift direction
001014 - Platform drift speed
002040 - Method of removing platform direction and speed from current
033022 - Quality of buoy satellite transmission
033023 - Quality of buoy location
033027 - Location quality class (range of radius of 66% confidence)
022063 - Total water depth
302021 - Waves
302022 - Wind waves
302023 - Swell waves
025025 - Battery voltage
002034 - Drogue type
007070 - Drogue depth
002190 - Lagrangian drifter submergence
025086 - Depth correction indicator
002035 - Cable length
002168 - Hydrostatic pressure of lower end of cable
020031 - Ice deposit (thickness)
306004 - Digitization, depth/salinity method, depths/salinities/temperatures
002030 - Method of current measurement
306005 - Time/duration of current measurement, depths/directions/speeds
007031 - Height of barometer above MSL

302001 - Pressure and pressure change
007032 - Height of thermometer above platform
012101 - Dry-bulb temperature (scale 2)
012103 - Dew-point temperature (scale 2)
013003 - Relative humidity
007032 - Height of anemometer above platform
002169 - Anemometer type
002002 - Type of instrumentation for wind measurement
008021 - Time significance (value = “2" (time averaged))
004025 - Time period in minutes
011001 - Wind direction
011002 - Wind speed
008021 - Time significance (value = "missing”)
004025 - Time period in minutes
011043 - Maximum wind gust direction
011041 - Maximum wind gust speed
007030 - Height of station above MSL (redefine height to previous level)
004024 - Time period in hours
013011 - Total precipitation
008021 - Time significance (value = “3" (accumulated))
004024 - Time period in hours
014021 - Global radiation, integrated over period specified
008021 - Time significance (value = "missing”)

A3.2.1.9 BUFR Template for simple AMDAR

(see also ANNEX to paragraph 3.5.1.2 for new and more elaborated Template for AMDAR)

001006 - Aircraft identifier
002061 - Aircraft navigational system
301011 - Year, month, and day
301013 - Hour, minute, and second
301021 - Latitude and longitude (high accuracy)
008004 - Phase of aircraft flight
007010 - Height or altitude (flight level)
002062 - Type of aircraft data relay system
002005 - Precision of temperature observation
012101 - Temperature/dry-bulb temperature (scale 2)
012103 - Dew-point temperature (scale 2)
013003 - Relative humidity
011001 - Wind direction
011002 - Wind speed
011031 - Degree of turbulence
011036 - Maximum derived equivalent vertical gust speed

Notes:
1. A method needs to be developed of reporting, within BUFR, the flight level value within Section 3, and such descriptor(s) should then be added to the above template. Note that this is not the same as the altitude value within Section 2, which is itself stored as 007010 in the above template.

A3.2.1.10 BUFR Template for AIREP

001006 - Aircraft identifier
301011 - Date
301012 - Time
301021 - Latitude and longitude (high accuracy)
007010 - Height or altitude (flight level)
012101 - Temperature/dry-bulb temperature (scale 2)
011001 - Wind direction
011002 - Wind speed
011031 - Degree of turbulence
020041 - Airframe icing

A3.2.1.11 BUFR Templates for METAR/SPECI

Existing METAR/SPECI templates have been developed initially to translate in BUFR the existing METAR/SPECI code form valid at that time. Future adjustment and refinement will be performed following ICAO requirements expressed to WMO.

Instead of sequence 307011, use the following new sequence:

001063 - ICAO location indicator
002001 - Type of station
301011 - Year, month, and day
301012 - Hour and minute
301023 - Latitude and longitude (coarse accuracy)
007031 - Height of barometer above MSL
007032 - Height of anemometer above ground
011001 - Wind direction
011016 - Extreme counterclockwise wind direction of a variable wind
011017 - Extreme clockwise wind direction of a variable wind
011002 - Wind speed
011041 - Maximum wind speed (gusts)
007032 - Height of thermometer above ground
012101 - Temperature (scale 2)
012103 - Dewpoint temperature (scale 2)
010052 - Altimeter setting (QNH)
020009 - General Weather Indicator (TAF/METAR)

Instead of sequence 307018, use the following new sequence:

008016 - Change qualifier of a trend-type or aerodrome forecast
102000 - Delayed replication of 2 descriptors
031001 - Number of replications (up to 2)
008017 - Qualifier of the time when the forecast change is expected (FM,TL,AT)
301012 - Hour and minute
104000 - Delayed replication of 4 descriptors
031001 - Number of replications (up to 1)
007032 - Height of anemometer above ground
011001 - Wind direction
011002 - Wind speed
011041 - Maximum wind speed (gusts)
020009 - General Weather Indicator
101000 - Delayed replication of 1 descriptor
031001 - Number of replications (up to 1)
020001 - Horizontal visibility
307014 - Significant present weather sequence

A3.2.1.12 Existing sequences for METAR/SPECI in BUFR

307021 - Total sequence for representation of METAR/SPECI code in BUFR

						(Total sequence for representation of METAR/SPECI code in BUFR)
3	07	021	3	07	011	Main part of data
			3	07	012	D_VVVV
			3	07	013	$D_RD_RV_RV_RV_RV_R$
			3	07	014	W´w´
			3	07	015	Clouds group(s)
			3	07	016	REw´w´
			3	07	017	Wind shear on runway(s)
			3	07	018	Trend-type landing forecast
			3	07	015	Clouds group(s)

						(Main part of data for representation of METAR/SPECI code in BUFR)	
3	07	011	0	01	063	ICAO location indicator	CCCC
			0	02	001	Type of station	(AUTO)
			3	01	011	Year, month, day (YY)	
			3	01	012	GG, gg	
			3	01	024	Latitude-longitude (coarse accuracy), height of station	
			0	07	006	Height above station (= height of an anemometer)	
			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	11	002	Wind speed	ff
			0	11	041	Maximum wind speed (gusts)	f_mf_m
			0	07	006	Height above station (= height of a thermometer)	
			0	12	001	Temperature	T´T´
			0	12	003	Dew-point temperature	T´$_d$T´$_d$
			0	10	052	Altimeter setting (QNH)	$P_HP_HP_HP_H$
			0	20	009	General Weather Indicator TAF/METAR	
						(D_VVVVV)	
3	07	012	1	03	000	Delayed replication of 3 descriptors	
			0	31	001	Number of replication (up to 3)	
			0	08	023	First order statistics	
			0	05	021	Direction of visibility observed	D_V
			0	20	001	Horizontal visibility	VVV
						($D_RD_RV_RV_RV_RV_R$)	
3	07	013	1	06	000	Delayed replication of 6 descriptors	
			0	31	001	Number of replication (up to 4)	
			0	01	064	Runway designator	D_RD_R
			0	08	014	Qualification for runway visual range	
			0	20	061	Runway visual range	$V_RV_RV_RV_R$
			0	08	014	Qualification for runway visual range	
			0	20	061	Runway visual range	$V_RV_RV_RV_R$
			0	20	018	Tendency of runway visual range	i

						(w´w´)	
3	07	014	1	01	000	Delayed replication of 1 descriptor	
			0	31	001	Number of replication (up to 3)	
			0	20	019	Significant present weather	w´w´
						(Clouds group(s))	
3	07	015	1	01	000	Delayed replication of 1 descriptor	
			0	31	001	Number of replication	
			3	02	005	($N_sN_sN_s$, CC, $h_sh_sh_s$)	
			0	20	002	Vertical visibility	VV$h_sh_sh_s$
						(REw´w´)	
3	07	016	1	01	000	Delayed replication of 1 descriptor	
			0	31	001	Number of replication (up to 3)	
			0	20	020	Significant recent weather phenomena	REw´w´
						(Wind shear on runways(s))	
3	07	017	1	01	000	Delayed replication of 1 descriptor	
			0	31	001	Number of replication	
			0	11	070	Runway designator of the runway affected by wind shear (including ALL)	WS RWYD_RD_R
						(Trend-type landing forecast)	
3	07	018	0	08	016	Change qualifier of a trend-type	TTTTT
						Forecast or an aerodrome forecast	
			1	02	000	Delayed replication of 2 descriptors	
			0	31	001	Number of replication (up to 2)	
			0	08	017	Qualifier of the time when the forecast	TT
						Change is expected (FM, TL, AT)	
			3	01	012	GG, gg	
			1	04	000	Delayed replication of 4 descriptor	
			0	31	001	Number of replication (up to 1)	
			0	07	006	Height above station	
			0	11	001	Wind direction	ddd
			0	11	002	Wind speed	ff
			0	11	041	Maximum wind speed (gusts)	f_mf_m
			0	20	009	General Weather Indicator	
			1	01	000	Delayed replication of 1 descriptor	
			0	31	001	Number of replication (up to 1)	
			0	20	001	Horizontal visibility	VVVV
			3	07	014	W´w´	
						(Short METAR/SPECI)	
3	07	020	3	07	011	Main part of data	
			3	07	014	W´w´	
			3	07	016	REw´w´	

ANNEX TO PARAGRAPH 3.2.2

A3.2.2.1 New descriptors:

0 12 151	Standard deviation of daily mean temperature	K	2	0	12
0 12 118	Maximum temperature at height specified, past 24 hours	K	2	0	16
0 12 119	Minimum temperature at height specified, past 24 hours	K	2	0	16
0 04 051	Principal time of daily reading of maximum temperature	Hour	0	0	5
0 04 052	Principal time of daily reading of minimum temperature	Hour	0	0	5
0 08 050	Qualifier for number of missing values in calculation of statistic	Code table	0	0	4
0 04 059	Times of observation used to compute the reported mean values	Flag table	0	0	6

0 08 050

Qualifier for number of missing values in calculation of statistic

Code figure	
0	Reserved
1	Pressure
2	Temperature
3	Extreme temperature
4	Vapour pressure
5	Precipitation
6	Sunshine duration
7	Maximum temperature
8	Minimum temperature
9	Wind
10-14	Reserved
15	Missing value

0 04 059

Times of observation used to compute the reported mean values

Bit No.	
1	00 UTC
2	06 UTC
3	12 UTC
4	18 UTC
5	Other hours
All 6	Missing value

A3.2.2.2 A BUFR template for CLIMAT data

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 (= 1) (1)	Day
3 01 012	0 04 004	Hour (= 0) (1)	Hour
	0 04 005	Minute (=0) (1)	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 04 023		Time period (= number of days in the month)	Day
		Monthly mean values of pressure, temperature, extreme temperatures and vapour pressure	
0 08 023		First order statistics (= 4; mean value)	Code table
0 10 004		Pressure	Pa, scale –1
0 10 051		Pressure reduced to mean sea level	Pa, scale –1
0 07 004		Pressure (standard level)	Pa, scale –1
0 10 009		Geopotential height of the standard level	gpm
0 07 032		Height of sensor above local ground	m, scale 2
0 12 101		Temperature/dry-bulb temperature	K, scale 2
0 02 051		Indicator to specify observing method for extreme temperatures	Code table
0 04 051		Principal time of daily reading of maximum temperature	Hour
0 12 118		Maximum temperature at height specified, past 24 hours	K, scale 2
0 04 052		Principal time of daily reading of minimum temperature	Hour
0 12 119		Minimum temperature at height specified, past 24 hours	K, scale 2
0 13 004		Vapour pressure	Pa, scale -1
0 08 023		First order statistics (= 63; missing value)	Code table
0 12 151		Standard deviation of daily mean temperature	K, scale 2
0 07 032		Height of sensor above local ground (set to missing to cancel the previous value	m, scale 2
1 02 005		Replicate 2 descriptors 5 times	
0 08 050		Qualifier for number of missing values in calculation of statistic (= 1, 2, 4, 7, 8)	Code table
0 08 020		Total number of missing entities (days)	Numeric
		Sunshine duration	
0 14 032		Total sunshine	Hour
0 14 033		Total sunshine	%
0 08 050		Qualifier for number of missing values in calculation of statistic (= 6; sunshine duration)	Code table
0 08 020		Total number of missing entities (days)	Numeric
		Number of days of occurrence	
1 02 018		Replicate 2 descriptors 18 times	

0 08 052		Conditions for which number of days of occurrence follows (= 0,1, 2, 3, 4, 5, 6, 7, 8, 16, 17, 18, 19, 20, 21, 22, 23, 24)	Code table
0 08 022		Total number (of days)	Numeric
		Occurrence of extreme values of temperature and wind speed	
0 07 032		Height of sensor above local ground	m, scale 2
0 08 053		Day of occurrence qualifier	Code table
0 04 003		Day	Day
0 12 152		Highest daily mean temperature	K, scale 2
0 08 053		Day of occurrence qualifier	Code table
0 04 003		Day	Day
0 12 153		Lowest daily mean temperature	K, scale 2
0 08 053		Day of occurrence qualifier	Code table
0 04 003		Day	Day
0 08 023		First order statistics (= 2; maximum value)	Code table
0 12 101		Temperature/dry-bulb temperature	K, scale 2
0 08 053		Day of occurrence qualifier	Code table
0 04 003		Day	Day
0 08 023		First order statistics (= 3; minimum value)	Code table
0 12 101		Temperature/dry-bulb temperature	K, scale 2
0 08 023		First order statistics (= 63; missing value)	Code table
0 07 032		Height of sensor above local ground	m, scale 2
0 02 002		Type of instrumentation for wind measurement	Flag table
0 08 053		Day of occurrence qualifier	Code table
0 04 003		Day	Day
0 11 046		Maximum instantaneous wind speed	m, scale 1
0 08 053		Day of occurrence qualifier (set to missing to cancel the previous value)	Code table
		Precipitation	
0 04 003		Day (= 1) (2)	Day
0 04 004		Hour (= 6) (2)	Hour
0 04 023		Time period (= number of days in the month) (2)	Day
0 07 032		Height of sensor above local ground	m, scale 2
0 13 060		Total accumulated precipitation	kg m^{-2}, scale 1
0 13 051		Frequency group; precipitation	Code table
0 04 053		Number of days with precipitation equal to or more than 1 mm	Numeric
0 08 050		Qualifier for number of missing values in calculation of statistic (= 5; precipitation)	Code table
0 08 020		Total number of missing entities (days)	Numeric
		Number of days of occurrence	
1 02 006		Replicate 2 descriptors 6 times	
0 08 052		Conditions for which number of days of occurrence follows (= 10,11, 12, 13, 14, 15 - precipitation)	Code table
0 08 022		Total number (of days)	Numeric
		Occurrence of extreme precipitation	
0 08 053		Day of occurrence qualifier	Code table
0 04 003		Day	Day
0 13 052		Highest amount of precipitation	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
		NORMALS	

0 04 001		Year (of beginning of the reference period)	Year
0 04 001		Year (of ending of the reference period)	Year
0 04 002		Month	Month
0 04 003		Day (= 1) (1)	Day
0 04 004		Hour (= 0) (1)	Hour
0 04 022		Time period (= 1)	Month
		Normals of monthly mean pressure, temperatures, vapour pressure and of standard deviation	
0 08 023		First order statistics (= 4; mean value)	Code table
0 10 004		Pressure	Pa, scale –1
0 10 051		Pressure reduced to mean sea level	Pa, scale –1
0 07 004		Pressure (standard level)	Pa, scale –1
0 10 009		Geopotential height of the standard level	gpm
0 07 032		Height of sensor above local ground	m, scale 2
0 12 101		Temperature/dry-bulb temperature	K, scale 2
0 02 051		Indicator to specify observing method for extreme temperatures	Code table
0 04 051		Principal time of daily reading of maximum temperature	Hour
0 12 118		Maximum temperature at height specified, past 24 hours	K, scale 2
0 04 052		Principal time of daily reading of minimum temperature	Hour
0 12 119		Minimum temperature at height specified, past 24 hours	K, scale 2
0 13 004		Vapour pressure	Pa, scale -1
0 12 151		Standard deviation of daily mean temperature	K, scale 2
0 07 032		Height of sensor above local ground (set to missing to cancel the previous value)	m, scale 2
		Normal of sunshine duration	
0 14 032		Total sunshine	Hour
0 08 023		First order statistics (= 63; missing value)	Code table
0 04 001		Year (of beginning of the reference period)	Year
0 04 001		Year (of ending of the reference period)	Year
0 04 002		Month	Month
0 04 003		Day (= 1) (2)	Day
0 04 004		Hour (= 6) (2)	Hour
0 04 022		Time period (= 1)	Month

		Normals of precipitation	
0 07 032		Height of sensor above local ground	m, scale 2
0 08 023		First order statistics (= 4; mean value)	Code table
0 13 060		Total accumulated precipitation	kg m^{-2}, scale 1
0 04 053		Number of days with precipitation equal to or more than 1 mm	Numeric
0 08 023		First order statistics (= 63; missing value)	Code table
1 02 006		Replicate 2 descriptors 6 times	
0 08 050		Qualifier for number of missing values in calculation of statistic (= 1, 2, 3, 4, 5, 6)	Code table
0 08 020		Total number of missing entities (years)	Numeric

Notes:

1) The time identification refers to the beginning of the one-month period.

2) In case of precipitation measurements, the one-month period begins at 06 UTC on the first day of the month and ends at 06 UTC on the first day of the following month.

3) If the height of the sensor was changed during the period specified, the value shall be that which existed for the greater part of the period.

A3.2.2.3 A BUFR template for CLIMAT SHIP data

0 01 011		Ship's call sign	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 (= 1) (1)	Day
3 01 012	0 04 004	Hour (= 0) (1)	Hour
	0 04 005	Minute (= 0) (1)	Minute
3 01 023	0 05 002	Latitude (coarse accuracy)	Degree, scale 2
	0 06 002	Longitude (coarse accuracy)	Degree, scale 2
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 04 023		Time period (= number of days in the month)	Day
		Monthly mean values of pressure, temperature, vapour pressure and sea/water temperature	
0 08 023		First order statistics (= 4; mean value)	Code table
0 10 051		Pressure reduced to mean sea level	Pa, scale –1
0 07 032		Height of sensor above local ground	m, scale 2
0 12 101		Temperature/dry-bulb temperature	K, scale 2
0 13 004		Vapour pressure	Pa, scale -1
0 07 032		Height of sensor above local ground (set to missing to cancel the previous value)	m, scale 2
0 22 043		Sea/water temperature	K, scale 2
0 08 023		First order statistics (= 63; missing value)	Code table
		Precipitation	
0 04 003		Day (= 1) (2)	Day
0 04 004		Hour (= 6) (2)	Hour
0 04 023		Time period (= number of days in the month) (2)	Day
0 07 032		Height of sensor above local ground	m, scale 2
0 13 060		Total accumulated precipitation	kg m^{-2}, scale 1
0 13 051		Frequency group; precipitation	Code table
0 04 053		Number of days with precipitation equal to or more than 1 mm	Numeric
		NORMALS	
0 04 001		Year (of beginning of the reference period)	Year
0 04 001		Year (of ending of the reference period)	Year
0 04 002		Month	Month
0 04 003		Day (= 1) (1)	Day
0 04 004		Hour (= 0) (1)	Hour
0 04 022		Time period (= 1)	Month
		Normals of monthly mean pressure, temperature, vapour pressure and sea/water temperature	
0 08 023		First order statistics (= 4; mean value)	Code table
0 10 051		Pressure reduced to mean sea level	Pa, scale –1
0 07 032		Height of sensor above local ground	m, scale 2
0 12 101		Temperature/dry-bulb temperature	K, scale 2
0 13 004		Vapour pressure	Pa, scale -1
0 07 032		Height of sensor above local ground (set to missing to cancel the previous value	m, scale 2
0 22 043		Sea/water temperature	K, scale 2

0 08 023		First order statistics (= 63; missing value)	Code table
0 04 001		Year (of beginning of the reference period)	Year
0 04 001		Year (of ending of the reference period)	Year
0 04 002		Month	Month
0 04 003		Day (= 1) (2)	Day
0 04 004		Hour (= 6) (2)	Hour
0 04 022		Time period (= 1)	Month
		Normals of precipitation	
0 07 032		Height of sensor above local ground	m, scale 2
0 08 023		First order statistics (= 4; mean value)	Code table
0 13 060		Total accumulated precipitation	kg m^{-2}, scale 1
0 04 053		Number of days with precipitation equal to or more than 1 mm	Numeric
0 08 023		First order statistics (= 63; missing value)	Code table

Notes:

1) The time identification refers to the beginning of the one-month period.

2) In case of precipitation measurements, the one-month period begins at 06 UTC on the first day of the month and ends at 06 UTC on the first day of the following month.

3) If the height of the sensor was changed during the period specified, the value shall be that which existed for the greater part of the period.

3.2.2.4 A BUFR template for CLIMAT TEMP and CLIMAT TEMP SHIP data

3 01 001	0 01 001	WMO block number	Numeric
	0 01 002	WMO station number	Numeric
0 01 011		Ship's call sign	CCITT IA5
3 01 011	0 04 001	Year	Year
	0 04 002	Month	Month
	0 04 003	Day (= 1) (1)	Day
3 01 012	0 04 004	Hour (= 0) (1)	Hour
	0 04 005	Minute (= 0) (1)	Minute
3 01 023	0 05 002	Latitude (coarse accuracy)	Degree, scale 2
	0 06 002	Longitude (coarse accuracy)	Degree, scale 2
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 release of sonde above mean sea level	m
0 04 023		Time period (= number of days in the month)	Day
0 04 059		Times of observations used to compute the reported mean values	Flag table
1 15 010		Replicate 15 descriptors 10 times (surface and 9 standard levels)	
0 08 023		First order statistics (= 4; mean value)	Code table
0 07 004		Pressure	Pa, scale –1
0 08 001		Vertical sounding significance	Flag table
0 10 009		Geopotential height	gpm
0 12 101		Temperature/dry-bulb temperature	K, scale 2
0 12 103		Dew-point temperature	K, scale 2
0 08 023		First order statistics (= 32; vector mean)	Code table
0 11 001		Wind direction	Degree true
0 11 002		Wind speed	m s^{-1}
0 08 023		First order statistics (= 63; missing value)	Code table
0 11 019		Steadiness of wind	%
0 08 050		Qualifier for number of missing values in calculation of statistic (= 2; temperature)	Code table
0 08 020		Total number of missing entities (days)	Numeric
0 08 050		Qualifier for number of missing values in calculation of statistic (= 9; wind)	Code table
0 08 020		Total number of missing entities (days)	Numeric

Note:

The time identification refers to the beginning of the one-month period.

ANNEX TO PARAGRAPH 3.3

New Common Sequences descriptors:

3-10-023 Geostationary satellite radiance data

3-01-072	Satellite identification
0-30-021	Number of pixels per row
0-30-022	Number of pixels per column
0-08-012	Land/sea qualifier
0-07-024	Satellite zenith angle
0-07-025	Solar zenith angle
0-10-002	Height
1-01-012	Replicate next descriptor 12 times
3-04-032	Cloud fraction
1-05-002	Replicate next 5 descriptors 2 times
0-02-152	Satellite instrument used in data processing
0-02-024	Integrated mean humidity computational method
0-07-004	Pressure
0-07-004	Pressure
0-13-003	Relative humidity
1-01-012	Replicate next descriptor 12 times
3-04-033	Radiance

3-10-024 Geostationary satellite radiance data

3-01-072	Satellite identification
0-30-021	Number of pixels per row
0-30-022	Number of pixels per column
0-08-012	Land/sea qualifier
0-07-024	Satellite zenith angle
0-07-025	Solar zenith angle
0-10-002	Height
1-01-003	Replicate next descriptor 3 times
3-04-032	Cloud fraction
1-05-002	Replicate next 5 descriptors 2 times
0-02-152	Satellite instrument used in data processing
0-02-024	Integrated mean humidity computational method
0-07-004	Pressure
0-07-004	Pressure
0-13-003	Relative humidity
1-01-003	Replicate next descriptor 3 times
3-04-033	Radiance

ANNEX TO PARAGRAPH 3.4.2

A3.4.2.1 Template and sample data of BUFR for Tropical Cyclone Tracks derived from EPS to be included in Attachment of the Manual on Codes, Volume I.2

TEMPLATE FOR TROPICAL CYCLONE TRACKS INFORMATION DERIVED FROM EPS

Note: ^ means space in the sample data below.

Table ref.	Element name	1st subset	2nd subset		Bits
0 01 033	Identification of originating/generating centre	34	34	...	8
0 01 034	Identification of originating/generating subcentre	0	0	...	8
0 01 032	Generating application	70	70		8
0 01 025	Storm identifier	15W	15W	...	24
0 01 027	WMO long storm name	DANAS^^^^^	DANAS^^^^^	...	80
0 01 090	Technique for making up initial perturbations	1	1	...	8
0 01 091	Ensemble member number	1	2	...	10
0 01 092	Type of ensemble forecast	1	3	...	8
3 01 011	Year	2001	2001	...	12
	Month	9	9	...	4
	Day	8	8	...	6
3 01 012	Hour	0	0	...	5
	Minute	0	0	...	6
1 08 000	Delayed replication of 8 descriptors				
0 31 001	Delayed descriptor replication factor (the number of forecast hours)	7	7	...	8
0 08 021	Time significance (forecast time)	4	4	...	5
0 04 014	Time increment	0	0	...	11
0 08 005	Meteorological attribute significance (storm centre)	1	1	...	4
3 01 023	Latitude Longitude (coarse accuracy)	11850	11840	...	15
		32360	32190	...	16
0 10 051	Pressure reduced to mean sea level	9500	9450	...	14
0 08 005	Meteorological attribute significance (location of maximum wind)	3	3	...	4
3 01 023	Latitude Longitude (coarse accuracy)	11630	11640	...	15
		32250	32210	...	16
0 11 012	Wind speed at 10m	412	437	...	12
	Time significance (forecast time) } Replicate 5 times	...	...	...	...
	...	...	...	...	...
	Wind speed at 10m	...	...	...	...
	Time significance (forecast time)	4	4	...	5
	Time increment	12	12	...	11
	Meteorological attribute significance (storm centre)	1	1	...	4
	Latitude (coarse accuracy)	12520	12360	...	15
	Longitude (coarse accuracy)	31950	31780	...	16
	Pressure reduced to mean sea level	9700	9600	...	14
	Meteorological attribute significance (location of maximum wind)	3	3	...	4
	Latitude (coarse accuracy)	12430	123300	...	15
	Longitude (coarse accuracy)	32010	31800	...	16
	Wind speed at 10m	283	360	...	12

A3.4.2.2 New descriptors for Tropical Cyclone Tracks derived from EPS

Table ref.	Element name	Unit	Scale	Ref. value	Data width (Bits)
0 01 090	Technique for making up initial perturbations	Code table	0	0	8
0 01 091	Ensemble member number	Numeric	0	0	10
0 01 092	Type of ensemble forecast	Code table	0	0	8

		Unit	Scale	Data width (Character)
B 01 090		Code table	0	3
B 01 091		Numeric	0	4
B 01 092		Code table	0	3

A3.4.2.3 New Code Tables

0 01 090
Technique for making up initial perturbations

Code figure	
0	LAF (Lagged-Average Forecasting)
1	Breeding
2	Singular vectors
3	Multiple analysis cycles
4-191	Reserved
192-254	Reserved for local use
255	Missing value

0 01 092
Type of ensemble forecast

Code figure	
0	Unperturbed high-resolution control forecast
1	Unperturbed low-resolution control forecast
2	Negatively perturbed forecast
3	Positively perturbed forecast
4-191	Reserved
192-254	Reserved for local use
255	Missing value

ANNEX TO PARAGRAPH 3.5.1.2

Table 1 - AMDAR reporting requirements and current GTS codes

Element no	Element		FM 42 –XI Et	FM 94 BUFR DESCRIPTOR (BUFR Table B)		RELATED SEQUENCE DESCRIPTOR(S)		Data Source			
								ASDAR	ADS	Other AMDAR	Note
1	**Aircraft identifier**		I_A.....I_A	0 01 006		3 01 051, 3 11 001		X	X	X	1
				0 01 006 0 01 008		3 01 065, 3 11 002				X	2
2	**Observation number**									X	3
3	**Phase of flight**		$i_pi_pi_p$	(0 08 004)		3 01 051, 3 11 001		X		X	4
						3 01 066, 3 11 002					
4	**Latitude**		$L_aL_aL_aL_aA$	0 05 001		3 01 021, 3 01 051, 3 11 001			X	X	5
				0 05 002		3 01 023, 3 01 066, 3 11 002		X	X	X	6
5	**Longitude**		$L_oL_oL_oL_oB$	0 06 001		3 01 021, 3 01 051, 3 11 001			X	X	5
				0 06 002		3 01 023, 3 01 066, 3 11 002		X	X	X	6
6	**Day and time of observation**		YYGGgg	Year	0 04 001	3 01 011	3 01 051, 3 11 001 3 01 066, 3 11 002		X		7
				Month	0 04 002				X		
				Day	0 04 003			(X)	X	X	8
				Hour	0 04 004	3 01 012	3 01 051, 3 11 001	X	X	X	
						3 01 013	3 01 066, 3 11 002				
				Minute	0 04 005	3 01 012	3 01 051, 3 11 001	X	X	X	
					0 04 005	3 01 013	3 01 066, 3 11 002				
				Second	0 04 006				X		7
7	**Pressure Altitude**		$S_hh_lh_lh_l$	(0 07 002)		3 11 001		X	X	X	9
8	**Static air temperature (SAT)**		$SST_AT_AT_A$	0 12 101		3 11 001 3 11 003, 3 11 002		X	X	X	
9	**Humidity**	**RH**	UUU	0 13 003					X	X	10
		Dew Pt	$SST_dT_dT_d$	0 12 103						X	
		Mixing ratio		0 13 002		3 11 003, 3 11 002				X	
10	**Wind Direction**		ddd	0 11 001		3 11 001 3 11 003, 3 11 002		X	X	X	
11/11a	**Wind speed/ Maximum wind**		fff	0 11 002		3 11 001 3 11 003, 3 11 002		X	X	X	
11b	**Wind quality/roll angle**			0 02 064		3 01 066, 3 11 002		X	X	X	11
12	**Turbulence**	**Degree of turbulence**	TBB_A	0 11 031		3 11 001		X		X	
		Vert. gust	$VGf_gf_gf_g$	0 11 036						X	12
		Intensity (EDR)		0 11 075						X	13
		Peak(EDR)		0 11 076		3 11 004, 3 11 002				X	
		Turbulence index (EDR)		0 11 037					X		14
		Time of peak EDR		(0 11 038)					X		14,15
		EDR reporting interval									16
13	**Airframe Icing**	**Ice/no ice**		(0 20 041)		3 11 001				X	17
		Pk liquid water content								X	18
		Av. liquid water content								X	
		Supercooled droplet conditions								X	

Notes on Table 1:

1. Identifiers include aircraft registration numbers, ASDAR identifiers, ICAO airframe numbers, flight numbers and arbitrary numbers relating to specific programmes. The current BUFR Table B descriptor is suitable.
2. Flight number does not uniquely identify a specific aircraft.
3. This is a new proposal to assist in data management and is to be attached to source data.
4. The current phase of flight table can be expanded to give more information on the derivation of source data and include a quality indicator related to aircraft attitude.
5. High-resolution position is available from most systems except ASDAR.
6. ASDAR positions are resolved to one minute of latitude or longitude.
7. ADS data include a full date/time group.
8. For ASDAR day of month is appended at the ground receiving station.
9. Flight level (also called pressure altitude) is downlinked from the aircraft. ASDAR and some AMDARs report to a resolution of 100ft. The current requirement calls for a resolution of at least 10ft (~3m) hence a new descriptor is needed.
10. A sensor is currently under development for operational deployment. ADS data format allows for RH reporting.
11. Also included in phase of flight.
12. Reported by most non-US AMDARS.
13. Reported by some US AMDARs.
14. Specified for ADS.
15. Descriptor does not cover adequate range for ADS reports.
16. Needed to qualify EDR measurements.
17. Ice/no ice required from AMDAR. Sensor available on most aircraft.
18. ARINC 620 downlink code available.

Table 2
Proposed New BUFR Template for AMDAR

Element		FM 94 BUFR DESCRIPTOR (BUFR Table B)	RELATED SEQUENCE DESCRIPTOR(S) (BUFR Table D)		Notes
Aircraft identifier		0 01 006		**3 11 005**	1
Sequence number		**0 01 023**			2, Table 3
Latitude		0 05 001	3 01 021		
Longitude		0 06 001			
Year		0 04 001	3 01 011		
Month		0 04 002			4, Table 4
Day		0 04 003			
Hour		0 04 004	3 01 013		
Minute		0 04 005			
Second		0 04 006			
Pressure Altitude (flight level)		**0 07 010**	***In 3 11 006***		5, Table 3
Detailed phase of aircraft flight		**0 08 009**			3, Table 3
Wind Direction		0 11 001	***In 3 11 006***		6, Table 4
Wind speed/ Maximum wind		0 11 002			
Degree of turbulence		0 11 031			
Maximum derived equivalent gust speed		0 11 036			
Static air temperature (SAT)		0 12 101	***In 3 11 006***		
ACARS interpolated values		0 33 025			
Phase of flight		0 08 004			
Wind quality/roll angle		0 02 064	***In 3 11 006***		6, Table 4
Humidity	RH	0 13 003			
	Dew Pt	0 12 103	***In 3 11 006***		6, Table 4
	Mixing ratio	0 13 002			
Turbulence (EDR)	Delayed replication of two descriptors	1 02 000			7
	Delayed descriptor replication factor	0 31 001			7
	Intensity (EDR)	0 11 075			
	Peak(EDR)	0 11 076			
	Turbulence index (EDR)	0 11 037			
	Extended time of occurrence of peak EDR	**0 11 039**			8, Table 3
	EDR reporting interval	**0 11 077**			9, Table 3
Airframe Icing	Ice/no ice	**0 20 042**			10, Table 3
	Peak liquid water content	**0 20 043**			11, Table 3
	Average liquid water content	**0 20 044**			11, Table 3
	Supercooled water droplet conditions	**0 20 045**			11, Table 3

Notes on Table 2:

1. This identifier can cope with ASDAR, ADS and other AMDAR identities. ADS reports use a 24-bit ICAO airframe identifier, equating to an 8-character BCD number.

2. The sequence number is a simple observation count to be included in the downlinked message. It should be reset at 0000 UTC each day and is especially useful for quality control, data management and archiving purposes.

3 This phase of flight table is expanded to indicate wind quality from roll angle (or roll and pitch combined) and also to indicate the method of ascent and descent observation interval selection either by time or pressure increments.

4 The new sequence descriptor includes the basic data measured by all current AMDAR platforms together with turbulence elements measured by most modern systems. The message is readily expanded to include Eddy Dissipation Rate, water vapour and icing information, should it become generally available by using the additional descriptors shown.

5 Flight level is defined relative to the ICAO standard sea level pressure and is readily converted to static air pressure using standard formulae. Once converted, the original resolution (either 100ft or 10ft) is lost, hence it is desirable to disseminate the element in the received form. The descriptor shown is designed to deal with high-resolution flight level data.

6 The new sequence descriptor groups data appropriate to encoding a single sounding from ascent or descent data from a single aircraft. Note that not all the 3 11 006 sequence is included in 3 11 005.

7 Some aircraft report up to 10 pairs of EDR values per observation. The corresponding times and position could be found by interpolation from the previous report.

8 The new table allows observation intervals up to one hour. The existing descriptor (0 11 038) allowed up to 15 minutes only whereas observation intervals of 30 minutes or more are commonly used.

9 The EDR observing interval and associated averaging time differs according to individual observing schedule and cannot be assumed to be identical to the observation interval for the main elements. It is desirable to include this information in the coded data.

10 Ice/no ice indication is available on some aircraft. The current code table did not allow for this simple report.

11 A special automatic icing report, including these elements, is expected to become available from some aircraft and a downlink code has been published.

Table 3

Proposed additions to BUFR Table B

TABLE REFERENCE	TABLE ELEMENT NAME	BUFR				CREX		
F X Y		UNIT	SCALE	REFERENCE VALUE	DATA WIDTH (Bits)	UNIT	SCALE	DATA WIDTH (characters)
0 01 023	Observation sequence number	Numeric	0	0	9	Numeric	0	3
0 08 009	Detailed phase of flight	Code Table	0	0	4	Code table	0	2
0 07 010	Flight level	m	0	-1024	16	ft	1	5
0 11 039	Extended time of occurrence of peak Eddy Dissipation Rate	Code table	0	0	6	Code table	0	2
0 11 077	Reporting interval or averaging time for Eddy Dissipation Rate	s	0	0	12	s	0	4
0 20 042	Airframe icing present	Code table	0	0	2	Code table	0	1
0 20 043	Peak liquid water content	Kg m^{-3}	4	0	7	Kg m^{-3}	4	2
0 20 044	Average liquid water content	Kg m^{-3}	4	0	7	Kg m^{-3}	4	2
0 20 045	Supercooled large droplet (SLD) conditions	Code table	0	0	2	Code table	0	2

Proposed New Code Tables:

0 08 009

Detailed phase of aircraft flight

Code figure	
0	Level flight, routine observation, unsteady
1	Level flight, highest wind encountered, unsteady
2	Unsteady (UNS)
3	Level flight, routine observation (LVR)
4	Level flight, highest wind encountered (LVW)
5	Ascending (ASC)
6	Descending (DES)
7	Ascending, observation intervals selected by time increments
8	Ascending, observation intervals selected by time increments, unsteady
9	Ascending, observation intervals selected by pressure increments
10	Ascending, observation intervals selected by pressure increments, unsteady
11	Descending, observation intervals selected by time increments
12	Descending, observation intervals selected by time increments, unsteady
13	Descending, observation intervals selected by pressure increments
14	Descending, observation intervals selected by pressure increments, unsteady
15	Missing value

0 11 039

Extended Time of Occurrence of Peak Eddy Dissipation Rate

Code figure	Minutes prior to observation time (min)
0	min < 1
1	1 <= min < 2
2	2 <= min < 3
3	3 <= min < 4
4	4 <= min < 5
5	5 <= min < 6
6	6 <= min < 7
7	7 <= min < 8
8	8 <= min < 9
9	9 <= min < 10
10	10 <= min < 11
11	11 <= min < 12
12	12 <= min < 13
13	13 <= min < 14
14	14 <= min < 15
15-59	As above to 59 <=min < 60
60	No timing information available
61-62	Reserved
63	Missing value

0 20 042

Airframe Icing present

Code figure	
0	No icing
1	Icing present
2	Reserved
3	Missing value

0 20 045

Supercooled large droplet (SLD) conditions

Code figure	
0	No SLD conditions present
1	SLD conditions present
2	Reserved
3	Missing value

Table 4

Proposed additions to BUFR table D

TABLE REFERENCE			TABLE REFERENCES			ELEMENT NAME
F	X	Y				
						(Standard AMDAR reports)
3	11	005	0	01	006	Aircraft identifier
			0	01	023	Sequence number
			3	01	021	Latitude and longitude
			3	01	011	Year, month and day
			3	01	013	Hour, minute and second
			0	07	010	Flight level
			0	08	009	Detailed phase of flight
			0	11	001	Wind direction
			0	11	002	Wind speed
			0	11	031	Degree of turbulence
			0	11	036	Derived equivalent vertical gust speed
			0	12	101	Temperature/dry-bulb temperature
			0	33	025	ACARS interpolated values
						(AMDAR sounding data)
3	11	006	0	07	010	Flight level
			0	11	001	Wind direction
			0	11	002	Wind speed
			0	02	064	Roll angle quality
			0	12	101	Temperature/dry-bulb temperature
			0	12	103	Dew-point temperature

Table 5

Proposed template for AMDAR profile

Element	**FM 94 BUFR descriptor/ sequence descriptor (BUFR Table B/D)**	**Notes**	**CREX descriptor**
Aircraft identifier	0 01 006		B 01 006
Year, month, day	3 01 011	Date/Time and position of first level in profile	D 01 011
Hour, Min, second	3 01 013		D 01 013
Latitude, Longitude	3 01 021		D 01 021
Phase of flight	0 08 004	Ascent or descent profile	B 08 004
Delayed replication of one descriptor	1 01 000		R 01 000
Delayed descriptor replication factor	0 31 001	Number of levels following	
AMDAR sounding data	**3 11 006**		**D 11 006**

ANNEX TO PARAGRAPH 3.5.2

New Class 35 BUFR/CREX descriptors:

Bulletin being monitored (CCCC)				
0-35-023	CCITT IA5	0	0	32
B-35-023	Character	0		4
Bulletin being monitored (BBB)				
0-35-024	CCITT IA5	0	0	24
B-35-024	Character	0		3

Change units of the following descriptors currently existing in BUFR/CREX Class 35:

Bulletin being monitored (TTAAii)				
0-35-021	CCITT IA5	0	0	48
B-35-021	Character	0		6
Bulletin being monitored (YYGGgg)				
0-35-022	CCITT IA5	0	0	48
B-35-022	Character	0		6

ANNEX TO PARAGRAPH 3.5.3

New Common Code Table C-11 - Originating Centres

CREX B-01-035 (5 characters)	Sect.1/ Octets 6-7 in GRIB Edition 2 BUFR 0-01-035 (16 bits)	
0 to 254	*0 to 254*	*See Common Table C-1*
255 to 10000	255 to 10000	Reserved for centres in Region I which are not in the list above
10001 to 20000	10001 to 20000	Reserved for centres in Region II which are not in the list above
20001 to 30000	20001 to 30000	Reserved for centres in Region III which are not in the list above
30001 to 40000	30001 to 40000	Reserved for centres in Region IV which are not in the list above
40001 to 50000	40001 to 50000	Reserved for centres in Region V which are not in the list above
50001 to 65534	50001 to 65534	Reserved for centres in Region VI which are not in the list above
65535	65535	Missing value
65536 to 99999	n.a.	Not used

Add descriptor in Class 1:

0 01 035	Originating Centre	Common Code Table C-11	0	0	16
B 01 035			0		5

Add note under Common Table C-1:

(4) In case all entries of a band reserved to a specific Region have been allocated, it will be allowed to attribute an entry in another Region band, if necessary.

ANNEX TO PARAGRAPH 3.5.4

New BUFR/CREX descriptors:

Emissivity				
0-14-050	%	1	0	10
B-14-050	%	1		4
Snow cover				
0-20-065	%	0	0	7
B-20-065	%	0		3

Notes:
Emissivity is the ratio of the amount of energy emitted from a particular object vs. the amount that would be emitted by a blackbody at the same temperature (I.e. the Planck function). Multiplying by 100 gives a percent (and provides 2 digits of precision at the same time!).

Snow cover will be reported for each satellite pixel as a percentage of coverage of the pixel, and it does not seem feasible to try to use existing descriptor 0-20-062 for such a purpose because the use of that descriptor additionally implies details on, e.g. snow drifts, wet vs. dry snow, etc. that a satellite obviously cannot accurately detect.

ANNEX TO PARAGRAPH 3.5.5

Add a note to regulation 94.5.4.1 in BUFR:

Note: Where a replication operation includes delayed replication(s) within the scope of its replication, the replication (or repetition) factor descriptor(s) from class 31 shall be counted for X, except the one (if any) located immediately after the replication descriptor for which X is being calculated, as in the following example:

106000 031001 008002 103000 031001 005002 006002 010002.

ANNEX TO 3.5.6.2

New BUFR/CREX descriptors for new Rawinsonde data:

1.	Radiosonde serial number	0-01-081	CCITT IA5	0	0	16
						0
		B-01-081	Character	0		20
2.	Radiosonde ascension number	0-01-082	Numeric	0	0	14
		B-01-082	Numeric	0		4
3.	Radiosonde release number	0-01-083	Numeric	0	0	3
		B-01-083	Numeric	0		1
4.	Balloon lot number	0-01-093	CCITT IA5	0	0	96
		B-01-093	Character	0		12
5.	WBAN Number	0-01-094	Numeric	0	0	17
		B-01-094	Numeric	0		5
6.	Observer identification	0-01-095	CCITT IA5	0	0	32
		B-01-095	Character	0		4
7.	Radiosonde configuration	0-02-016	Flag table	0	0	5
		B-02-016	Flag table	0		2
8.	Radiosonde ground receiving system	0-02-066	Code table	0	0	6
		B-02-066	Code table	0		2
9.	Radiosonde operating frequency	0-02-067	Hz	-5	0	15
		B-02-067	Hz	-5		5
10.	Balloon manufacturer	0-02-080	Code table	0	0	6
		B-02-080	Code table	0		2
11.	Type of balloon	0-02-081	Code table	0	0	5
		B-02-081	Code table	0		2
12.	Weight of balloon	0-02-082	Kg	3	0	12
		B-02-082	Kg	3		4
13.	Type of balloon shelter	0-02-083	Code table	0	0	4
		B-02-083	Code table	0		2
14.	Type of gas used in balloon	0-02-084	Code table	0	0	4
		B-02-084	Code table	0		2
15.	Amount of gas used in balloon	0-02-085	Kg	3	0	13
		B-02-085	Kg	3		4
16.	Balloon flight train length	0-02-086	m	1	0	10
		B-02-086	m	1		4
17.	Type of pressure sensor	0-02-095	Code table	0	0	5
		B-02-095	Code table	0		2
18.	Type of temperature sensor	0-02-096	Code table	0	0	5
		B-02-096	Code table	0		2
19.	Type of humidity sensor	0-02-097	Code table	0	0	5
		B-02-097	Code table	0		2
20.	Type of surface observing equipment	0-02-115	Code table	0	0	5
		B-02-115	Code table	0		2
22.	Flight level significance	0-08-040	Code table	0	0	6
		B-08-040	Code table	0		2
23.	Data significance	0-08-041	Code table	0	0	5
		B-08-041	Code table	0		2
24.	Relative humidity	0-13-009	%	1	-1000	12
		B-13-009	%	1		4
25.	Software identification	0-25-061	CCITT IA5	0	0	96
		B-25-061	Character	0		12
26.	Orientation correction (azimuth)	0-25-065	Degree	2	-1000	11
		B-25-065	Degree	2		4
27.	Orientation correction (elevation)	0-25-066	Degree	2	-1000	11
		B-25-066	Degree	2		4
28.	Radiosonde release point pressure correction	0-25-067	Pa	0	-8000	14
		B-25-067	Pa	0		4

29.	Number of archive recomputes	0-25-068	Numeric	0	0	7
		B-25-068	Numeric	0		3
30.	Flight level pressure corrections	0-25-069	Flag table	0	0	8
		B-25-069	Flag table	0		3
31.	Data quality check indicator	0-33-015	Code table	0	0	6
		B-33-015	Code table	0		2
32	Reason for termination	0-35-035	Code table	0	0	5
		B-35-035	Code table	0		2

Additional note under BUFR/CREX Class 1:

(12) Descriptor 0-01-082 s to be used for reporting the sequential number of the current radiosonde reporting period (e.g. synoptic cycle) within a given year or other similar locally-defined length of time. Descriptor 0-01-083 ito be used in the case of multiple sequential radiosonde releases during a single reporting period (e.g. synoptic cycle), in order to indicate which particular release generated the corresponding data values.

New code and flag tables:

Radiosonde configuration (0-02-016)

Bit	Meaning
1	Train regulator
2	Light unit
3	Parachute
4	Rooftop release
All 5	Missing value

Radiosonde ground receiving system (0-02-066)

Code	Meaning
0	ART-1
1	ART-2
2	VIZ GPS
3	Vaisala GPS
4	ATIR
5	Sippican GPS
6	IMS GPS
7-61	Reserved
62	Other
63	Missing value

Balloon manufacturer (0-02-080)

Code	Meaning
0	Kaysam
1	Totex
2	KKS
3-61	Reserved
62	Other
63	Missing value

Type of balloon (0-02-081)

Code	Meaning
0	GP26
1	GP28
2	GP30
3	HM26
4	HM28
5	HM30
6	SV16
7-29	Reserved
30	Other
31	Missing value

Type of balloon shelter (0-02-083)

Code	Meaning
0	High bay
1	Low bay
2	BILS
3	Roof-top BILS
4-13	Reserved
14	Other
15	Missing value

Type of gas used in balloon (0-02-084)

Code	Meaning
0	Hydrogen
1	Helium
2	Natural Gas
3-13	Reserved
14	Other
15	Missing value

Type of pressure sensor (0-02-095)

Code	Meaning
0	Capacitance aneroid
1	Derived from GPS
2	Resistive strain gauge
3-29	Reserved
30	Other
31	Missing value

Type of temperature sensor (0-02-096)

Code	Meaning
0	Rod thermistor
1	Bead thermistor
2	Capacitance bead
3-29	Reserved
30	Other
31	Missing value

Type of humidity sensor (0-02-097)

Code	Meaning
0	VIZ Mark II Carbon Hygristor
1	VIZ B2 Hygristor
2	Vaisala A-Humicap
3	Vaisala H-Humicap
4	Capacitance sensor
5	Vaisala RS90
6	Sippican Mark IIA Carbon Hygristor
7-29	Reserved
30	Other
31	Missing value

Type of surface observing equipment (0-02-115)

Code	Meaning
0	PDB
1	RSOIS
2	ASOS
3	Psychrometer
4	F420
5-29	Reserved
30	Other
31	Missing value

Flight level significance (0-08-040)

Code	Meaning
0	High resolution data sample
1	Within 20 hPa of surface
2	Pressure less than 10 hPa (i.e., 9, 8, 7, etc.) when no other reason applies
3	Base pressure level for stability index
4	Begin doubtful temperature, height data
5	Begin missing data (all elements)
6	Begin missing RH data
7	Begin missing temperature data
8	Highest level reached before balloon descent because of icing or turbulence
9	End doubtful temperature, height data
10	End missing data (all elements)
11	End missing RH data
12	End missing temperature data
13	Zero degrees C crossing(s) for RADAT
14	Standard pressure level
15	Operator added level
16	Operator deleted level
17	Balloon re-ascended beyond previous highest ascent level
18	Significant RH level
19	RH level selection terminated
20	Surface level
21	Significant temperature level
22	Mandatory temperature level
23	Flight termination level
24	Tropopause(s)
25	Aircraft report
26	Interpolated (generated) level
27	Mandatory wind level
28	Significant wind level
29	Maximum wind level
30	Incremental wind level (fixed regional)
31	Incremental height level (generated)
32	Wind termination level
33	Pressure 100 to 110 hPa, when no other reason applies
34-39	Reserved
40	Significant thermodynamic level (inversion)
41	Significant RH level (per NCDC criteria)
42	Significant temperature level (per NCDC)
43-61	Reserved
62	Other
63	Missing value

Data significance (0-08-041)

Code	Meaning
0	Parent site
1	Observation site
2	Balloon manufacture date
3	Balloon launch point
4	Surface observation
5	Surface observation displacement from launch point
6	Flight level observation
7	Flight level termination point
8-30	Reserved
31	Missing value

Flight Level Pressure Corrections (0-25-069)

Bit	Meaning
1	Smoothed
2	Baseline adjusted
3	Normalized time interval
4	Outlier checked
5	Plausibility checked
6	Consistency checked
7	Interpolated
All 8	Missing value

Data Quality Check Indicator (0-33-015)

Code	Meaning
0	Passed all checks
1	Missing-data check
2	Descending/reascending balloon check
3	Data plausibility check (above limits)
4	Data plausibility check (below limits)
5	Superadiabatic lapse rate check
6	Limiting angles check
7	Ascension rate check
8	Excessive change from previous flight
9	Balloon overhead check
10	Wind speed check
11	Wind direction check
12	Dependency check
13	Data valid but modified
14	Data outlier check
15-62	Reserved
63	Missing value

Reason for termination (0-35-035)

Code	Meaning
0	Balloon burst
1	Balloon forced down by icing
2	Leaking or floating balloon
3	Weak or fading signal
4	Battery failure
5	Ground equipment failure
6	Signal interference
7	Radiosonde failure
8	Loss of GPS signal
9	Limiting angles
10	Excessive missing data frames
11	Excessive missing temperature
12	Excessive missing pressure
13	User terminated
14	Software error
15-29	Reserved
30	Other
31	Missing value

Add the following new entries to existing descriptor 0-33-035 (Manual/automatic quality control):

Code	Meaning
6	Automatic quality control flagged data as questionable and not manually checked
7	Automatic quality control flagged data as questionable and manually checked and failed
8	Manually checked and failed
9-14	Reserved

ANNEX TO PARAGRAPH 3.5.7

Proposed Table B entries

Table Reference	Element name	BUFR				CREX		
F X Y		Unit	Scale	Ref. value	Data width	Unit	Scale	Data width
0 01 037	SIGMET sequence number	Numeric	0	0	5	Numeric	0	2
0 08 019	Qualifier for following centre identifier	Code table	0	0	4	Code table	0	1
0 20 028	Expected change in intensity	Code table	0	0	3	Code table	0	1
0 27 035	Length of phenomenon	m	-3	0	13	m	-3	4
0 28 035	Width of phenomenon	m	-3	0	13	m	-3	4

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

13 Forecasts
14 Warnings

Code tables for proposed new Table B descriptors:

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

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

New Table D descriptors:

		(SIGMET header)
3 16 020	1 02 002	Replication of 2 descriptors two times (Define validity period)
	3 01 011	Year, Month, Day
	3 01 012	Hour, Minute
	0 01 037	SIGMET sequence number
	0 08 019	Qualifier for location identifier, 1=ATS unit serving FIR
	0 01 062	Short ICAO location identifier
	0 08 019	Qualifier for location identifier, 2=FIR, 3=UIR, 4=CTA
	0 01 063	ICAO location identifier
	0 08 019	Qualifier for location identifier, 6=MWO
	0 01 062	Short ICAO location identifier
	0 08 019	Qualifier for location identifier, Missing=Cancel
		(Volcanic ash SIGMET, Volcano details)
3 16 021	0 08 011	Meteorological feature, 17=Volcanic ash/Special clouds
	0 01 022	Name of feature
	0 08 007	Dimensional significance, 0=Point
	3 01 023	Location
	0 08 007	Dimensional significance, Missing=Cancel
		(Volcanic ash SIGMET, Obs or Fcst area and motion)
3 16 022	0 08 021	Time Significance, 16=Analysis, 4=Forecast
	3 01 011	Year, Month, Day
	3 01 012	Hour, Minute
	0 07 010	Flight level (base of cloud)
	0 07 010	Flight level (top of cloud)
	0 27 035	Length of phenomenon
	0 28 035	Width of phenomenon
	0 08 007	Dimensional significance, 2=Area
	1 01 000	Replicate one descriptor
	0 31 001	Replication count
	3 01 023	Latitude, longitude
	0 19 005	Direction of motion
	0 19 006	Speed of motion
	0 08 007	Dimensional significance, Missing=cancel
	0 20 090	Type of cloud, 5=Volcanic Ash/Eruption
	0 20 028	Expected change in intensity
	0 08 021	Time significance, Missing=cancel
		(Volcanic ash SIGMET, Fcst area)
3 16 023	0 08 021	Time Significance, 4=Forecast
	3 01 011	Year, Month, Day
	3 01 012	Hour, Minute
	0 08 007	Dimensional significance, 2=Area
	1 01 000	Replicate one descriptor
	0 31 001	Replication count
	3 01 023	Latitude, longitude
	0 08 007	Dimensional significance, Missing=cancel
	0 20 090	Type of cloud, 5=Volcanic Ash/Eruption
	0 08 021	Time significance, Missing=cancel
		(Volcanic ash SIGMET, Outlook)
3 16 024	0 08 021	Time Significance, 4=Forecast
	3 01 011	Year, Month, Day

	3 01 012	Hour, Minute
	1 07 000	Replicate 7 descriptors
	0 31 001	Replication count
	0 07 010	Flight level (base of cloud)
	0 07 010	Flight level (top of cloud)
	0 08 007	Dimensional significance, 2=Area
	1 01 000	Replicate one descriptor
	0 31 001	Replication count
	3 01 023	Latitude, longitude
	0 08 007	Dimensional significance, Missing=cancel
	0 20 090	Type of cloud, 5=Volcanic Ash/Eruption
	0 08 021	Time significance, Missing=cancel

ANNEX TO PARAGRAPH 3.5.8

New descriptor for use in reporting certain types of AIRS satellite data :

Principal component score	0-25-050	Numeric	4	-131072	18
	B-25-050	Numeric	4		6

ANNEX TO PARAGRAPH 3.5.9

Additional entries in BUFR code tables to support JASON satellite data

1. Append an asterisk to the element name for existing descriptor 0-25-060 in order to indicate that the actual meaning may be obtained from the originator of the data.

2. Additional Table B descriptors.

		Unit	Scale	Ref	Bits
0 02 173	Square of the off nadir angle	square degrees	4	0	10
0 04 007	Seconds within a minute (microsecond accuracy)	s	6	0	26
0 08 029	Remotely sensed surface type	Code table	0	0	8
0 08 074	Altimeter echo type	Code table	0	0	2
0 08 076	Type of band	Code table	0	0	6
0 13 090	Radiometer water vapor content	kg m^{-2}	0	0	7
0 13 091	Radiometer liquid content	kg m^{-2}	0	0	7
0 21 128	Number of valid points per second used to derive previous parameters	Numeric	0	0	8
0 25 095	Altimeter state flag	Flag table	0	0	2

0 25 096	Radiometer state flag	Flag table	0	0	5
0 25 097	Three-dimensional error estimate of the navigator orbit	Code table	0	0	4

3. Additional entries in existing Code tables

0 01 007 - Common Code Table C-5 : add 2 entries:

260	JASON-1
261	JASON-2

0 02 020: add 1 entry:

261	JASON

0 02 048: add 2 entries:

9	POSEIDON altimeter
10	JMR (Jason Microwave Radiometer)

0 08 023: add 1 entry:

13	Root mean square

4. Additional code and flag tables

0 08 029 Remotely sensed surface type

Value	Meaning
0	open ocean or semi-enclosed sea
1	enclosed sea or lake
2	continental ice
3	land
4-254	reserved
255	Missing value

0 08 074 Altimeter echo type

Value	Meaning
0	open ocean or semi-enclosed sea
1	non-ocean like
2	reserved
3	Missing value

0 08 076 Type of band

Value	Meaning
0	Ku
1	C
2-62.1	Reserved
63	Missing value

0 25 095 Altimeter state flag

Bit	Indicator
1	Altimeter operating (0 if nominal, 1 if backup)

All 2	Missing value

0 25 096 Radiometer state flag

Bit	Indicator
1	Mode indicator (0 if Mode 2, 1 if Mode 1)
2	Mode 1 Calibration sequence indicator (0 if normal data taking either Mode 1 or 2, 1 if Mode 1 Calibration sequence)
	Bits 3 and 4 indicate active 23.8 GHz channel(s):
3	Channel 2 (0 if on, 1 if off)
4	Channel 3 (0 if on, 1 if off)
All 5	Missing value

0 25 097 Three-dimensional error estimate of the navigator orbit

Code	Meaning
0	Ranges between 0 and 30 cm
1	Ranges between 30 and 60 cm
2	Ranges between 60 and 90 cm
3	Ranges between 90 and 120 cm
4	Ranges between 120 and 150 cm
5	Ranges between 150 and 180 cm
6	Ranges between 180 and 210 cm
7	Ranges between 210 and 240 cm
8	Ranges between 240 and 270 cm
9	Ranges larger than 270 cm
10-14	Reserved
15	Missing value

ANNEX TO PARAGRAPH 3.6.1

New BUFR/CREX descriptors and operators:

0-33-045	Probability of following event	%	0	0	7
B-33-045		%	0		3
0-33-046	Conditional probability of following event with respect to specified conditioning event	%	0	0	7
B-33-046		%	0		3
2-41-000	Define event				
C-41-000					
2-41-255	Cancel define event				
C-41-999					
2-42-000	Define conditioning event				
C-42-000					
2-42-255	Cancel define conditioning event				
C-42-999					
0-33-042	Type of limit represented by following value	Code table	0	0	3
B-33-042		Code table	0		1

New Code table:

0-33-042 - Type of limit represented by following value

Code Figure	Meaning
0	Exclusive lower limit (>)
1	Inclusive lower limit (>=)
2	Exclusive upper limit (<)
3	Inclusive upper limit (=<)
4-6	Reserved
7	Missing value

Add the following notes under BUFR/CREX Class 33:

(1) When using descriptor 0-33-045 or 0-33-046, operator 2-41-000 shall be used in order to define the following event to which the reported probability value applies.

(2) When using descriptor 0-33-046, operator 2-42-000 shall precede the occurrence of this descriptor in order to define the event upon which the reported probability value is conditioned.

(3) When defining an event for use with descriptor 0-33-045 or 0-33-046, descriptor 0-33-042 may be employed in order to indicate that the following value is actually a bound for a range of values.

Add the following new operators for Categorical Forecasts:

2-43-000 Categorical forecast values follow
C-43-000

2-43-255 Cancel categorical forecast values follow
C-43-999

Add a new note under BUFR Table C and under CREX Table C:

“A categorical forecast value represents a “best guess” from among a set of related, and often mutually-exclusive, data values or categories. Operator 2-43-000 may be used to designate one or more values as being categorical forecast values, and descriptor 0-33-042 may be employed preceding any such value in order to indicate that that value is actually a bound for a range of values.”

ANNEX TO PARAGRAPH 3.6.2

New BUFR Table C operator descriptor:

Table Reference:
2-07-Y

Operator Name:
Increase scale, reference value and data width

Operator Definition:
For Table B elements which are not CCITT IA5 (character data), code tables, or flag tables:

1. Add Y to the existing scale factor

2. Multiply the existing reference value by 10^Y.

3. Add $((10 \times Y) + 2) \div 3$ bits to the existing bit width. Note that this expression should be evaluated using integer division (ie. as an integer divided by integer 3) in order to ensure uniformity of results across various computer platforms.

Reword of Notes to BUFR Table C as follows:

(1) The operations specified by operator descriptors 2 01, 2 02, 2 03, 2 04, and 2 07 remain defined until cancelled or until the end of the subset.

(4) Nesting of operator descriptors must guarantee unambiguous interpretation. In particular, operators defined within a set of replicated descriptors must be cancelled or completed within that set, and the 2 07 operator may not be nested within any of the 2 01, 2 02, and 2 03 operators, nor vice-versa.

The following discussion describes the derivation of the above formula for modifying the bit width:

If we assign:

s_0 = old scale factor	s_1 = new scale factor
r_0 = old reference value	r_1 = new reference value
b_0 = old bit width	b_1 = new bit width

then the upper bound of actual numbers that we can encode (including the "missing" value) using the old and new values, respectively, are

$(2^{b_0} - 1 + r_0) \div 10^{s_0}$ and $(2^{b_1} - 1 + r_1) \div 10^{s_1}$.

Now, we want to ensure that

$$(2^{b_0} - 1 + r_0) \div 10^{s_0} \leq (2^{b_1} - 1 + r_1) \div 10^{s_1}$$

and solving this inequality for b_1 yields

$$b_1 \geq \ln(((2^{b_0} - 1 + r_0) \div 10^{s_0} \times 10^{s_1}) - r_1 + 1) \div \ln(2)$$

However, by definition, we also know that

$s_1 = s_0 + Y$ and $r_1 = r_0 \times 10^Y$,

which, via substitution and simplification, allows us to rewrite the above inequality as

$$b_1 \geq \ln((2^{b_0} - 1) \times (10^Y) + 1) \div \ln(2)$$

Now, the above expression, being solely a function of the old bit width and the desired increase in scale, seems simple enough to implement in practice, and we can always round the result upward to the next largest integer (using, e.g. the "ceiling" function); therefore, at least at first glance, it appears that we have a workable formula for determining b_1. However, the computed result will always be a real number, and therefore we must remain mindful of the issues relating to floating-point representation on computer systems. Specifically, suppose that a particular pair of Y and b_0 values yielded a computed result that was very close to an integer. Could we guarantee that we would always get the same result on any two computers running anywhere in the world? As an example, suppose that, for a particular case, one computer obtained a result of 20.001 and another obtained a result of 19.999? Then, applying the "ceiling" function in each case would yield two different values of 21 and 20, respectively, for b_1! Obviously, we want to avoid such a situation at all costs in order to maintain the machine-independent nature of BUFR, so it seems then that we must resort to a different approach in order to guarantee that two computers running anywhere in the world for any particular pair of Y and b_0 values always obtain the same result for b_1. In practice, this turns out to be more straightforward than one might think!

To see this, first of all note that

$$\ln((2^{b_0} - 1) \times (10^Y) + 1) < \ln((2^{b_0}) \times (10^Y) + 1)$$

Also, note that, for any real and positive X, it is true that

$$\lim_{X \to \infty} (\ln(X + 1) - \ln(X)) = 0$$

Therefore, for any Y and b_0, we can redefine the upper bound b_1 via the inequality

$$b_1 \geq \ln((2^{b_0}) \times (10^Y)) \div \ln(2)$$

$$= \ln(2^{b_0}) \div \ln(2) + \ln(10^Y) \div \ln(2)$$

$$= b_0 + (Y) \times (\ln(10) \div \ln(2))$$

Or, written another way,

$$(b_1 - b_0) \geq (Y) \times (\ln(10) \div \ln(2))$$

In other words, the required increase in bit width is always an upper bound to the increase in scale multiplied by the constant $(\ln(10) \div \ln(2))$. A rather straightforward computer simulation lends further proof to this assertion while also showing that, for each increase of scale represented in the first column below, the corresponding increase of bit width in the second column is always sufficient for every possible b_0:

1	4
2	7
3	10
4	14
5	17

6	20
7	24
8	27
9	30
10	34

The above table covers all but the most extreme cases and could be published as a look-up table within the BUFR regulations, thereby ensuring that any BUFR encoder/decoder programs running anywhere in the world always utilized the same increase in bit width for a given increase in scale. However, there is an even better way which allows the above table to be extended for any theoretical increase of scale but which at the same time avoids any of the aforementioned pitfalls of differing floating-point representation schemes. Namely, if we let n represent the first column above, then, the second column is given by $(10 \times n + 2) \div 3$ when computed using integer division.

ANNEX TO PARAGRAPH 3.6.3

New BUFR Table C operator descriptor:

Table Reference:
2-08-*Y*
Operator Name:
Change character data width
Operation Definition:
Y characters from CCITT International Alphabet #5 (representing *Y* * 8 bits in length) replace the specified data width given for each CCITT IA5 element in Table B.

Note that the maximum value for *Y* is 255 and the rewording of Note (1) to BUFR Table C as follows:

(1) The operations specified by operator descriptors 2 01, 2 02, 2 03, 2 04, 2 07, and 2 08 remain defined until cancelled or until the end of the subset.

ANNEX TO PARAGRAPH 4.1

Modifications to FM 12 SYNOP, FM 13 SHIP and FM 14 SYNOP MOBIL for reporting precipitation and its global harmonisation

Group $6RRRt_R$: Change regulation 12.2.5.4 from:

"This group shall be omitted from the report:
(a) When no precipitation occurred during the reference period;
(b) When precipitation amount was not measured and data are not available.
The indicator i_R shall indicate which one of these conditions applies."

To:

"This group shall be:
(a) Coded with "RRR" = "000", (3 zeros) when precipitation is measured but no precipitation occurred during the reference period;
(b) Coded with "RRR" = "///", (3 solidi) when precipitation is normally measured but, is not available for the current report;
(c) Omitted when precipitation is not normally measured. In this case, i_R should be coded as 4.
(d) Existing Automated Weather Stations (AWS) may continue to report no precipitation with i_R coded as 3 and the $6RRRt_R$ group omitted. New systems and human observer should report the $6RRRt_R$ group with "RRR" = "000", (3 zeros) to indicate no precipitation occurred during the reference period.

Under 12.4 Section 3, change regulation 12.4.1 to say:

"The inclusion of groups with indicator figures 1 up to 6, and 8 and 9 shall be decided regionally. However group $7R_{24}R_{24}R_{24}R_{24}$ shall be included by all stations (with the exception of stations situated in the Antarctic) capable of doing so, once a day at one appropriate time of the main standard times (00, 06, 12 or 18 UTC)."

Consequential changes on Regional Associations Regulations

To put in harmonization reporting practices approved by CBS (and subsequently EC) and Regional Association Regulations, the following consequential modifications should be done by Regional Associations (if possible first recommended by the Regional Working Groups on Planning and Implementation of the WWW) following documents submitted by the Secretariat or better by the respective Rapporteurs on Data Management and/or Codes:

RA I:

No modification necessary

RA II

Delete regulation 2/12.13.2 "The inclusion of group $7R_{24}R_{24}R_{24}R_{24}$ in Section 3 of the synoptic report shall be left to national decision."

Modify beginning of regulation 6/12.13.3: "~~If the group is included in the synoptic report,~~ The precipitation amount for the 24-hour period immediately preceding the time of the synoptic report in question shall be reported for $7R_{24}R_{24}R_{24}R_{24}$. At 0000 UTC….."

RA III:

No modification necessary

RA IV:

No modification necessary

RA V

Delete regulation 5/12.11.1 "The inclusion of group $7R_{24}R_{24}R_{24}R_{24}$ in Section 3 of the synoptic report shall be left to national decision."

RA VI Already proposed for RA VI session of 2002.

ANNEX TO PARAGRAPH 4.2.1

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

a) Title. *Amend* the titles to read "FM 15-XII METAR Aerodrome routine meteorological report (with or without trend forecast)" and "FM 16-XII SPECI Aerodrome special meteorological report (with or without trend forecast)". *Reason: the term "selected special reports" has been deleted from ICAO Annex 3/ WMO Technical Regulations (C.3.1). The proposal would also align the titles used for METAR and SPECI with the one used for TAF Aerodrome forecast (Amendment 72 to Annex 3);*

b) Code form. *Add* "COR" after "METAR or SPECI"; *add* "NIL" before "(AUTO)". *Reason: there is an aeronautical requirement to identify corrected and missing reports (draft Amendment 73 to Annex 3);*

Delete brackets around AUTO. *Reason: proposed change in operational requirements (draft Amendment 73 to Annex 3);*

Add at end of NOTE (2): The code words "COR" and "NIL" shall be used as appropriate for corrected and missing reports, respectively.

c) 15.1.1. *Amend* to read as follows: "The code name METAR or SPECI shall be included at the beginning of each individual report." (Amendment 72 to Annex 3);

d) 15.4. *Amend* to read Code word AUTO, i.e. *delete* brackets. *Reason: the use of fully automated reports would be allowed for international air navigation under certain circumstances (draft Amendment 73 to Annex 3);*

e) 15.5.2. *Amend* in the first sentence "3 knots (2 m/s or 6 km/h) or less" to read "less than 3 knots (2 m/s or 6 km/h)". *Reason: proposed change in operational requirements (draft Amendment 73 to Annex 3);*

f) 15.5.3. *Amend* in the first sentence "greater than 3 knots (2 m/s or 6 km/h)" to read "3 knots (2 m/s or 6 km/h) or more". *Reason: proposed change in operational requirements (draft Amendment 73 to Annex 3)*;

g) 15.7.6. *Amend* the last sentence of a) to read "When the RVR is assessed to be more than 2 000 metres, it shall be reported as P2000". *Reason: proposed change in aeronautical requirements (draft Amendment 73 to Annex 3);*

h) 15.8.4 *Amend* the first sentence to read as follows: "Intensity shall be indicated only with precipitation, precipitation associated with showers and/or thundershowers, duststorm or sandstorm." *Reason: proposed change in aeronautical requirements (draft Amendment 73 to Annex 3);*

i) 15.8.8 *Add* in the last sentence after "aerodrome" the following words: "(i.e. within 8 km of the aerodrome reference point)". *Reason: proposed change in aeronautical requirements (draft Amendment 73 to Annex 3);*

j) 15.8.10 *Amend* "BLSA and BLSN" to read "BLSA, BLSN and VA". *Reason: proposed change in aeronautical requirements (draft Amendment 73 to Annex 3);*

k) 15.8.10. *Amend* the Note (1) to read as follows:

"Such weather phenomena should be reported with the qualifier VC only when observed between 8 km and 16 km of the aerodrome reference point". *Reason: proposed change in aeronautical requirements (draft Amendment 73 to Annex 3).*

FM 51-X Ext. TAF

a) Code form. *Add* "AMD" and "COR" after "TAF"; add "NIL or CNL" after "$Y_1Y_1G_1G_1G_2G_2$". *Reason: there is an aeronautical requirement to identify amended, corrected, missing and cancelled aerodrome forecasts (Amendment 72 and draft Amendment 73 to Annex 3);*
Add at end of NOTE (3): The code words "AMD", "CNL", "COR" and "NIL" shall be used as appropriate for amended, cancelled, corrected and missing forecasts, respectively.

b) 51.1.1 *Amend* to read as follows: "The code name TAF shall be included at the beginning of each individual aerodrome forecast. (Amendment 72 to Annex 3);

c) 51.3.3 *Amend* in the first sentence "3 knots (2 m/s or 6 km/h) or less" to read "less than 3 knots (2 m/s or 6 km/h)". *Reason: proposed change in operational requirements (draft Amendment 73 to Annex 3);*

FM 50-VIII Ext. WINTEM

A*dd* Note (5) indicating that "No aeronautical requirement for this code form is stated by ICAO for international air navigation in ICAO Annex 3/WMO Technical Regulations (C.3.1). *Reason: proposed change in aeronautical requirements (draft Amendment 73 to Annex 3).*

Code Table 4678

w'w'

a) Note (5). *Amend* the first sentence to read as follows: "Intensity shall be indicated only with precipitation, precipitation associated with showers and/or thundershowers, duststorm or sandstorm."; *Delete* the second sentence. *Reason: proposed change in aeronautical requirements (draft Amendment 73 to Annex 3*);

b) Note (9). *Amend* the second sentence to read: "When due to blowing snow the observer cannot determine whether or not snow is also falling from cloud, the only BLSN shall be reported". *Reason: proposed change in aeronautical requirements (draft Amendment 73 to Annex 3);* and

c) Note (13). *Amend* "BLSA and BLSN" to read "BLSA, BLSN and VA". *Reason: proposed change in aeronautical requirements (draft Amendment 73 to Annex 3)*.

d) Add under PRECIPITATION: **UP** Unknown precipitation. *Reason: to accommodate fully automated stations (draft Amendment 73 to Annex 3);*

e) Add Note (14): UP is to be used only in reports from fully automated stations unable to distinguish precipitation type. *Reason: to accommodate fully automated stations (draft Amendment 73 to Annex 3);*

ANNEX TO PARAGRAPH 4.3.2

For correct encoding of FM71 CLIMAT and FM75 CLIMAT TEMP:

Add next sentence to the regulation 75.4 as the latter part.

Solidi (/////) shall be reported for any missing value in the groups of a level for which any element or all are not available. No group shall be omitted at any level. Any missing element shall be reported by solidi.

ANNEX **LIST OF ACRONYMS**

ACARS	AirCraft Addressing and Reporting System
ADS	Astrophysics Data System (USA)
AFWA	Air Force Weather Agency
AIRS	Advanced Infra-Red Sounder
AMDAR	Aircraft Meteorological Data Relay
AMSU	Advanced Microwave Sounding Unit
ANSI	American National Standards Institute
API	Application Program Interface
AWIPS	Advanced Weather Interactive Processing System
AWS	Automatic Weather Station
ATSR	Along Tack Scanning Radiometer
BUFR	Binary Universal Form for data Representation
CBS	Commission for Basic Systems
CBS-Ext.(98)	Extraordinary session of CBS held in 1998
CCl	Commission for Climatology (WMO)
CIMO	Commission for Instruments and Methods of Observations
COST	European Co-Operation in the field of Scientific and Technical research
CREX	Character Representation form for data EXchange
DBCP	Drifting Buoy Cooperation Panel
DBMS	Data Base Management System
DCP	Data Collection Platform
DIF	Directory Interchange Format
DPFS	Data Processing and Forecasting Systems
DRT	Data Representation Template
DT	Data Template
DWD	Deutscher Wetter Dienst
EANPG	European Air Navigation Planning Group
EC	Executive Council of the WMO
ECMWF	European Centre for Medium-range Weather Forecast
EPS	Ensemble Prediction System
ESA	European Space Agency
ET	Expert Team
ET/EDF	Expert Team on Evolution of Data Formats
ET/DR&C	Expert Team on Data Representation and Codes
EUMETNET	European Meteorological Networks
EUMETSAT	EUropean organisation for the exploitation of METeorological SATellites
FNMOC	Fleet Numerical Meteorology and Oceanography Centre
FORTRAN	FORmula TRANslation
FTP	File Transfer Protocol
GDPS	Global Data Processing System
GDT	Grid Definition Template
GIF	Graphic Interchange Format
GIS	Geographic Information System
GOS	Global Observing System
GRIB 1	Processed data in the form of GRId-point values expressed in Binary form - GRIB Edition 1
GRIB 2	General Regularly distributed Information in Binary form - GRIB Edition 2
GTS	Global Telecommunications System
HTML	Hyper Text Markup Language
ICAO	International Civil Aviation Organisation
ICT	Implementation/Coordination Team (of CBS)
ICT/DRC	Implementation/Coordination Team on Data Representation and Codes
ID	Identifier
IEC	International Electrotechnical Commission
IEEE	Institution of Electrical and Electronics Engineers
IOC	International Oceanographic Commission
ISO	International Standards Organization
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine

	Meteorology
JMA	Japan Meteorological Agency
JPEG	Joint Photographic Experts Group format
LINUX	*Not an acronym – name of an operating system*
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)
NESDIS	National Environmental Satellite Data and Information Service
NMC	National Meteorological Centre
NMHS	National Meteorological or Hydrological Service
NMS	National Meteorological Service
NWP	Numerical Weather Prediction
NWS	National Weather Service
OMF	weather Observation Markup Format
OPAG	Open Programme Area Group (of CBS)
OPAG-ISS	Open Programme Area Group on Information Systems and Services
PDT	Product Definition Template
PNG	Portable Network Graphic
RA	Regional Association (WMO)
RASS	Radio Acoustic Sounding System
RDBC	Regional Data Bank Centre
RSMC	Regional Specialised Meteorological Centre
RTH	Regional Telecommunication Hub
SGDR&C	Sub-Group on Data Representation and Codes (CBS)
SGML	Standard Generalized Markup Language
SI	System International
SOOP	Ship Of Opportunity Programme
SST	Sea Surface Temperature
TCP	Tropical Cyclone Programme
TCP/IP	Transport Control Protocol/Internet Protocol
TDL	Techniques Development Laboratory
TIFF	Tagged Image File Format
UKMO	United Kingdom Meteorological Office
UNIX	*Not an acronym – name of an operating system*
UTC	Universal Time Coordinate
VOS	Voluntary Observing Ship
WAFC	World Area Forecasting Centre (ICAO)
WAFS	World Area Forecasting System
WGDM	Working Group on Data Management (CBS)
WGS	Working Group on Standards
WMO	World Meteorological Organization
WWW	World Weather Watch
W3C	World Wide Web Consortium
XML	eXtensible Markup Language