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| WORLD METEOROLOGICAL ORGANIZATION  COMMISSION FOR BASIC SYSTEMS  -----------------------------  THIRD MEETING OF  INTER-PROGRAMME EXPERT TEAM ON DATA REPRESENTATION MAINTENANCE AND MONITORING  BEIJING, CHINA, 20 - 24 JULY 2015 |  | IPET-DRMM-III / Doc. 7.4  (23. 6. 2015)  -------------------------  ITEM 7.4  ENGLISH ONLY |

**Migration Strategy for BUFR TEMP**

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**Summary and Purpose of Document**

To define a standard for the transmission of BUFR TEMP

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**ACTION PROPOSED**

The meeting is requested to review the proposal.

**ANNEXES:**

Discussions

Testing carried out over the course of the past 18 months has highlighted a flaw in the ability of many data producers to produce BUFR TEMP in compliance with B/C reg 25. The aforementioned centres have resorted to encoding parts A,B,C & D of the ascent to 4 individual BUFR messages. This approach has posed a number of problems primarily in the identification of the 4 bulletins, which are transmitted with identical headers.

Although a number of workarounds for the identification of the four parts have been proposed, the NWP community have continued to oppose the introduction of any data not fully comply with the requirements of B/C 25. Their reasoning being that many NWP systems are not configured for the assimilation of TEMP BUFR in four parts which (from their perspective) renders the data as unusable.

The issues outlined above were acknowledged by the CBS-Management group in May 2015, which recommended an extension of the deadline for the cessation of TEMP TAC transmissions to Sept 2016.

Whilst the extension of the dual transmission period is a step in the right direction, the successful conclusion of the migration project will be dependent upon a solution being found which is agreeable to both the NWP community and data producers.

Proposal

Many of the RadioSonde systems currently in use have the ability to produce BUFR direct from the instrument. Data produced in this manner will not require any form of pre-processing and complies with the definition of “Native BUFR”. Data producers should be strongly encouraged to switch their systems to the production of Native BUFR. Where this not possible, the translation of FM-35 / 36 to BUFR will be required.

The B/C regulations provide a link between the reporting practices for Traditional Alphanumeric Codes (TAC - as specified in the Manual on Codes, Volume I.1 and Volume II ) and the those for FM 94 BUFR and FM 95 CREX (as specified in the Manual on Codes, Volume I.2). Whilst the regulations clearly define the contents of the message on the assumption that “native[[1]](#footnote-1)” data has been used, little attention is given to the possibility that the data may have been derived from the conversion a FM-35 / 36 message.

To date testing of BUFR TEMP data has uncovered errors, which may be attributed to this conversion process (please note the list below is not comprehensive)–

* Incorrect Geo-Potential Heights. The reporting of Geo-potential Heights in FM-35 / 36 requires the omission of the thousands digit up to but not including 500 hPa. In decoding the data, the thousand digit needs to be inferred which can lead to errors. Testing of the BUFR data has uncovered a number instances where this has been the case.
* Temperature in BUFR is reported in Kelvin with a precision to 100ths of a degree. The same quantity is reported in FM-35 / 36 TAC in Celsius with a precision to 10ths of a degree. The B/C regulations specify the conversion from Celsius to Kelvin using a conversion factor of 273.15 (in the equation T = t + 273.15). In many cases this can lead to an offset of 0.05o.
* Wind speed reported to B/C25 BUFR and TAC FM35 / 36 are reported using different units and with differing levels of precision. In BUFR the wind speed is reported in metres per second, with a precision of tenths of a metre per second, whilst FM-35 winds are reported in either metres per second or Knots. The conversion of to BUFR may lead to errors where allowances are not made for the accuracy required.

In addition to the inaccuracies listed above the B/C regulations are also unclear on the structuring of a BUFR upper air bulletin. Although not exhaustive the following is an outline of what is regarded as acceptable to the project in terms of structure (My Thanks to Alexander Kats of Roshydromet for the definitions below).

* High Resolution Rich Content native BUFR:

This widely regarded as the target standard by the migration project for BUFR TEMP. This will contain significant, tropopause and max wind levels which are identified with 0-08-042, in full compliance with the B/C 25 regulations.

* High Resolution native BUFR:

Certain data producers are unable to produce soundings with Wind or Coordinates, the ascent being limited to PTU data only. This is a limitation of the observing practice and if structured properly should be considered acceptable.

* Low Resolution Rich Content native BUFR:

Although being regarded as “outdated”, many systems currently in use produce data at a lower resolution in ASCII format. The levels produced are limited in quantity and invariably do not contain either elapsed ascent time or coordinate information. Assuming that the resultant BUFR message is structured correctly, they are still of great use and should be regarded as acceptable.

* Reformatted TEMP

The last variant is unfortunately the most prevalent, with a majority of upper air transmissions on the GTS being structured in this manner. As outlined above many data producers have resorted to converting the 4 parts of the FM-35 / 36 output to individual BUFR messages.

There has been a lot of discussion over the ability of NWP systems to assimilate data constructed in this way and opinions on its validity are still divided. The lack of a consistent approach to the merging of the four parts, has effectively excluded this variant from the list of acceptable options.

Standard for the encoding of BUFR TEMP

The migration of FM35 & FM36 data to BUFR has reached an impasse, with the NWP community and certain of the data producers being unable to come to an agreement over an acceptable format.

For the project to progress we must change the original specification set down in B/C 25, to a standard which has been agreed upon by both the data producers and the NWP community. This will almost certainly entail changes in the production of the data.

To elaborate on the points above –

* By general agreement, the reformatting of the FM 35/ 36 parts to BUFR must be deterred. This should be reflected in the B/C regulations.
* The current B/C regulations stipulate that a message should be sent when –
* The ascent reaches the 100hPa level.
* A further message should be sent on completion of the ascent (balloon burst) containing data for the entire ascent.

This section of the regulations should be expanded to provide details of what is permissible in terms of the content of the message. The variants listed above should be used as an illustration.

* The ordering of the levels is extremely important to many NWP centres. The receipt of BUFR messages with levels which are not sequentially ordered can (and invariably will) will make the data unusable. As a consequence references in the regulations which legitimise the practice of sending unordered levels should be removed. An illustration of this is given below -

*B/C 25.7 Temperature, dew-point and wind data at pressure levels*

*Temperature, dew-point and wind data at pressure levels obtained during the radiosonde ascent shall be included in descending order with respect to pressure. Data at each pressure level shall be included only once. For example, if a significant level with respect to air temperature and relative humidity and a standard isobaric surface coincide, data for that level shall be included only once, the multiple attributes being indicated by Extended vertical sounding significance (Flag table 0 08 042) as specified in Regulation B/C 25.7.2.2.*

*Note: (1) If data are produced and collected in traditional TEMP codes, the order of pressure levels may correspond to the order of levels in Parts A, B, C and D, when converted into BUFR or CREX. In this case, data at a level may be included more than once.*

* The levels of precision observed in the BUFR conversion of elements such as pressure and temperature have introduced errors. As outlined above more guidance is needed where the conversion is made from FM35 / 36 encoded data. The B/C regulations should give guidance to ensure the translation is carried out in the correct manner.

Conclusion

The TDC Migration project originally envisioned that the translation of TEMP, would be carried out from Native BUFR. It has since become clear that many data producers will not be in a position to do so, and will instead be forced to translate from to BUFR FM 35 / 36.

Changes to the BC 25 regulations will not resolve this situation, but should be regarded as a step in the right direction.

1. NATIVE refers to data derived from the instrument and not subject to conversion from FM35 or FM36 [↑](#footnote-ref-1)