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| WORLD METEOROLOGICAL ORGANIZATION  COMMISSION FOR BASIC SYSTEMS  -----------------------------  FOURTH MEETING OF  INTER-PROGRAMME EXPERT TEAM ON DATA REPRESENTATION MAINTENANCE AND MONITORING  GENEVA, SWITZERLAND, 30 MAY - 3 JUNE 2016 |  | IPET-DRMM-IV / Doc. 2.2 (6)  (17. 5. 2016)  -------------------------  ITEM 2.2  ENGLISH ONLY |

GRIB

**Update of GRIB2 new compression method – CCSDS libaec**

*Submitted by Daniel Lee, Sibylle Krebber (DWD)*

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**Summary and Purpose of Document**

A new data representation template for GRIB (5.42) has been validated (see item 4.2.1 (1), Validation report G1). It is proposed that the updated, validated template is adopted into the Manual on Codes.

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**ACTION PROPOSED**

The meeting is invited to review the validated template, including updates that were applied during validation, and recommend it for fast-track approval in November 2016 (FT2016-2).

**ANNEXES:**

1. Kornblueh, L.; Rosenhauer, M.; Fucille, E.; Schnee, G.; Krebber, S. and D. Lee (2016): Validation report of GRIB2 new compression method – CCSDS libaec (2013-2.2.1 DRMM-I, IPET-DRMM-IV Doc 2.2(x))
2. Consultative Committee for Space Data Systems: Lossless Data Compression. CCSDS Recommendation for Space Data System Standards, CCSDS 121.0-B-2, Blue Book, May 2012.

**DISCUSSIONS**

Consultative Committee for Space Data Systems recommends a Golomb-Rice encoding scheme which is efficient in terms of size and encoding size for transmitting gridded data. In tests with meteorological data, it has been shown that this algorithm can be effectively applied to data from numerical weather prediction models. It has long been desired to be able to use this algorithm in GRIB and a proposed template implementing this has now been validated.

The template for CCSDS encoding has been in circulation in various forms since 2008 (proposed at first meeting of ET-DR&C). The proposed template was changed from the form proposed at IPET-DRMM I in order to better fit the community’s needs:

1. The proposed data representation template 5.42 was reduced to a smaller number of entries. This was done because they were not needed for encoding and decoding the values in section 7.
2. The entries “reference sample interval” and “block size” were added, matching the documentation in [2] on the algorithm’s implementation, as well as the library used for validation.

**PROPOSAL**

**Add** **Templates:**

Preliminary note: For most templates, details of the packing process are described in regulation 92.9.4

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| **Data Representation Template 5.42 - Grid point and spectral data - CCSDS recommended lossless compression.** | |
| Octet No. | Contents |
| 12 – 15 | Reference value (R) (IEEE 32-bit floating-point value) |
| 16 – 17 | Binary scale factor (E) |
| 18 – 19 | Decimal scale factor (D) |
| 20 | Number of bits required to hold the resulting scaled and referenced data values (see Note 1) |
| 21 | Type of original field values (see Code Table 5.1) |
| 22 | compression scheme version number of CCSDS 121.0-B recommended standard blue book (currently 2) (see Note 3) |
| 23 | Block size |
| 24-25 | Reference sample interval (see Note 3) |

Notes:

1. The intent of this template is to scale the grid point data to obtain the desired precision, if appropriate, and then subtract the reference value from the scaled field as is done using Data Representation Template 5.0. After this, the resulting grid point field can be treated as a grayscale image and encoded into the CCSDS recommended standard for lossless data compression code stream format. To unpack the data field, the CCSDS recommended standard for lossless data compression code stream is decoded back into an image, and the original field is obtained from the image data as described in regulation 92.9.4 Note (4).
2. The Consultative Committee for Space Data Systems (CCSDS) recommended standard for lossless data compression is the standard used by space agencies for the compression of scientific data transmitted from satellites and other space instruments. CCSDS recommended standard for lossless data compression is a very fast predictive compression algorithm based on the extended-Rice algorithm. It uses Golomb-Rice codes for entropy coding. The sequence of prediction errors is divided into blocks. Each block is compressed using a two-pass algorithm. In the first pass the best coding method for the whole block is determined. In the second pass, the output of the marker of the selected coding method is encoded as ancillary information along with prediction errors.  
     
   The coding methods include:
   * Golomb-Rice codes of a chosen rank
   * Unary code for transformed pairs of prediction errors
   * Fixed-length natural binary code if the block is found to be incompressible
   * Signaling to the decoder empty block if all prediction errors are zeroes
3. Consultative Committee for Space Data Systems: Lossless Data Compression.   
   CCSDS Recommendation for Space Data System Standards,   
   CCSDS 121.0-B-2, Blue Book, May 2012.

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| **Data Template 7.42 - Grid point and spectral data - CCSDS recommended lossless compression.** | |
| Octet No. | Contents |
| 6 - nn | CCSDS recommended standard for lossless data compression code stream |

**New entry in Code table 5.0 – Data representation template number**

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| --- | --- |
| Octet No. | Contents |
| 42 | Grid point and spectral data - CCSDS recommended lossless compression. |